PowerFlex® 700L Frame 1X Liquid-Cooled Adjustable Frequency AC Drive

Introduction

When reading this document, look for this symbol "**Step x**" to guide you through the 6 BASIC STEPS needed to install and perform a Basic Start-Up of the PowerFlex 700L Frame 1X drive. A Human Interface Module (HIM) is required to perform the Basic Start-Up routine covered in this document.

The information provided is intended for qualified drive service personnel only.

Reference Materials

For detailed PowerFlex 700 information including advanced start-up routines, programming, application considerations and related precautions, refer to the following publications online at www.rockwellautomation.com/literature:

Title	Publication
PowerFlex 700 Series B User Manual	20B-UM002
PowerFlex Network Communications Adapter User Manuals	20COMM-UM
PowerFlex 70 Enhanced Control and PowerFlex 700 Vector Control Reference Manual	PFLEX-RM004
Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives	DRIVES-IN001

To order paper copies of technical documentation, contact your local Rockwell Automation distributor or sales representative.

To find your local Rockwell Automation distributor, visit www.rockwellautomation.com/locations

Allen-Bradley Drives Technical Support

Use the contacts below for PowerFlex 700 technical support including spare parts information.

Online at...	By Email at...	By Telephone at...
www.ab.com/support/abdrives	support@drives.ra.rockwell.com	262-512-8176

Documentation in Other Languages

User Manuals are available in multiple languages at: www.rockwellautomation.com/literature

Select publication language and, for example, type "20B-UM002" in the search field.

Table of Contents

Catalog Number Explanation . . . 3

Step 1
Read the Precautions and General Information . . . 3
CE Conformity . . . 5
Component Locations . . . 8

Step 2
Mount the Drive . . . 9
Lifting . . . 9
Mounting Considerations . . . 11
Dimensions . . . 11

Step 3
Connect the Cooling Loop . . . 12
Drive Coolant Requirements . . . 12
Cooling Loop Application Guidelines . . . 14
Drive Coolant Connections . . . 15

Step 4
Wire the Drive . . . 15
Special Considerations . . . 15
Wire Recommendations . . . 17
General Grounding Requirements . . . 18
Power Wiring . . . 19
Drive, Fuse, and Circuit Breaker Ratings . . . 20
Using Input/Output Contactors . . . 21
Disconnecting MOVs and Common Mode Capacitors . . . 22

Step 5
I/O Wiring . . . 24
I/O Terminals . . . 25
I/O Wiring Examples . . . 27
Hardware Enable Circuitry (Vector Control Only) . . . 29
Encoder Interface Option (Vector Control Only) . . . 31
Resistance Temperature Detector (RTD) Board . . . 33

Step 6
Start-Up Check List . . . 37
Prepare For Drive Start-Up . . . 37
Information About Start-Up Motor Tests . . . 38
First Powerup Menu Structure . . . 39
Human Interface Module (HIM) Overview . . . 40
Start-Up Routines . . . 41
Running S.M.A.R.T. Start . . . 43
Running an Assisted Start Up . . . 43
Drive Status Indicators and DPI Port Locations . . . 44
Common I/O Programming Changes . . . 45
Troubleshooting – Abbreviated Fault & Alarm Listing . . . 46
Common Symptoms and Corrective Actions . . . 48
Manually Clearing Faults . . . 50
Parameter List – Vector Control Option (v6.xxx) . . . 51

Specifications . . . 55
Derate Guidelines . . . 58

Catalog Number Explanation

Each PowerFlex 700L Frame 1X drive can be identified by its catalog number, which is CNMD180W0ENNNC1. The catalog number is on the shipping label and drive data nameplate. The catalog number includes the drive and any factory-installed options.

Step 1 Read the Precautions and General Information

Qualified Personnel

ATTENTION: Only qualified personnel familiar with adjustable frequency AC drives and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply may result in personal injury and/or equipment damage.

Personal Safety

ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before performing any work on the drive. Measure the DC bus voltage at the **DC+ and DC– Test Pt.** sockets on the drive (see item 9 in Figure 1 on page 8 for location). The voltage must be zero.

ATTENTION: Risk of injury or equipment damage exists. DPI or SCANport host products must not be directly connected together via 1202 cables. Unpredictable behavior can result if two or more devices are connected in this manner.

ATTENTION: The drive start/stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

ATTENTION: Loss of control in suspended load applications can cause personal injury and/or equipment damage. Loads must always be controlled by the drive or a mechanical brake. Parameters 600…611 are designed for lifting/torque proving applications. It is the responsibility of the engineer and/or end user to configure drive parameters, test any lifting functionality and meet safety requirements in accordance with all applicable codes and standards.

Product Safety

ATTENTION: An incorrectly applied or installed drive can result in component damage or a reduction in product life. Wiring or application errors, such as, undersizing the motor, incorrect or inadequate AC supply, or excessive ambient temperatures may result in malfunction of the system.

ATTENTION: This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. If you are not familiar with static control procedures, reference *Guarding Against Electrostatic Damage, publication 8000-4.5.2* or any other applicable ESD protection handbook.

ATTENTION: An incorrectly applied or installed bypass system can result in component damage or reduction in product life. The most common causes are:

- Wiring AC line to drive output or control terminals.
- Improper bypass or output circuits not approved by Allen-Bradley.
- Output circuits which do not connect directly to the motor.

Contact Allen-Bradley for assistance with application or wiring.

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The "adjust freq" portion of the bus regulator function is extremely useful for preventing nuisance overvoltage faults resulting from aggressive decelerations, overhauling loads, and eccentric loads. It forces the output frequency to be greater than commanded frequency while the drive's bus voltage is increasing towards levels that would otherwise cause a fault. However, it can also cause either of the following two conditions to occur.

1. Fast positive changes in input voltage (more than a 10% increase within 6 minutes) can cause uncommanded positive speed changes. However an "OverSpeed Limit" fault (F25) will occur if the speed reaches [Maximum Speed] + [Overspeed Limit], (Parameters 82 and 83). If this condition is unacceptable, action should be taken to 1) limit supply voltages within the specification of the drive and, 2) limit fast positive input voltage changes to less than 10%. Without taking such actions, if this operation is unacceptable, the "adjust freq" portion of the bus regulator function must be disabled (see Parameters 161 and 162).

2. Actual deceleration times can be longer than commanded deceleration times. However, a "Decel Inhibit" fault (F24) is generated if the drive stops decelerating altogether. If this condition is unacceptable, the "adjust freq" portion of the bus regulator must be disabled (see Parameters 161 and 162). In addition, installing a properly-sized dynamic brake resistor will provide equal or better performance in most cases.

   Important: These faults are not instantaneous. Test results have shown that they can take between 2…12 seconds to occur.

ATTENTION: To guard against drive damage when using output contactors, the following information must be read and understood. One or more output contactors may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals. In addition, reconnecting a motor to an active drive (by closing the contactor) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor should be wired to a drive digital input that is programmed as "Enable." This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor is opened.

CE Conformity

Compliance with the Low Voltage Directive and Electromagnetic Compatibility Directive has been demonstrated using harmonized European Norm (EN) standards published in the Official Journal of the European Communities. PowerFlex 700L drives, including Frame 1X, comply with the EN standards listed below when installed according to this PowerFlex 700L Frame 1X Liquid-Cooled Adjustable Frequency AC Drive Installation Instructions.

CE Declarations of Conformity are available online at: www.rockwellautomation.com/products/certification/

Low Voltage Directive (2006/95/EC)

- EN 50178 Electronic equipment for use in power installations

EMC Directive (2004/108/EC)

- EN 61800-3 Adjustable speed elecrical power drive systems – Part 3: EMC product standard including specific test methods

General Considerations

- For CE compliance, drives must satisfy installation requirements related to both EN 50178 and EN 61800-3 provided in this document.
- PowerFlex 700L AC Drives comply with the EMC requirements of EN 61800-3 when installed according to good EMC practices and the instructions provided in this document. However, many factors can influence the EMC compliance of an entire machine or installation, and compliance of the drive itself does not ensure compliance of all applications.
- PowerFlex 700L drives are not intended to be used on public low-voltage networks which supply domestic premises. Without additional mitigation, radio frequency interference is expected if used on such a network. The installer is responsible to take measures such as supplementary line filters and enclosures to prevent interference, in addition to the installation requirements of this document.
- Requirements for supplementary mitigation related to specific high frequency emission limits are provided in Table 1.

Table 1 PowerFlex 700L Frame 1X RF Emission Compliance and Installation Requirements

Standard / Limits		
EN 61800-3 Cat. C1 EN 61000-6-3 CISPR11 Group 1 Class B	**EN 61800-3 Cat. C2 EN 61000-6-4 CISPR11 Group 1 Class A**	**EN 61800-3 Cat. C3 I ≤100 A Limits**
Compliance possible with supplementary mitigation (Consult factory)	Compliance possible with supplementary mitigation (Consult factory)	Compliant without supplementary EMC line filter for motor cable ≤5 m (16.4 ft)
More Stringent Limits ←	→	Less Stringent Limits

- The PowerFlex 700L Frame 1X drive generates harmonic current emissions on the AC supply system. When operated on a public network it is the responsibility of the installer or user to ensure that applicable requirements of the distribution network operator have been met. Consultation with the network operator and Rockwell Automation may be necessary.

ATTENTION: PowerFlex 700L Frame 1X drives produce DC current in the protective earthing conductor which may reduce the ability of RCDs (residual current-operated protective devices) or RCMs (residual current-operated monitoring devices) of type A or AC to provide protection for other equipment in the installation.

Installation Requirements Related to EN 50178 and the Low Voltage Directive

- The insulation system of the 480V PowerFlex 700L Frame 1X drive is designed to be CE compliant when connected to either “center-earthed” supply systems or “corner-earthed” supply systems for altitudes up to and including 2000 m (6525 ft).
- When used at altitudes above 2000 m (6525 ft) up to a maximum of 5000 m (16,404 ft), PowerFlex 700L Frame 1X drives may not be powered from a “corner-earthed” supply system in order to maintain compliance with the CE LV Directive.
- The PowerFlex 700L Frame 1X drive must be installed in a pollution degree 1 or 2 environment to be compliant with the CE LV Directive. Characteristics of the different pollution degree ratings are provided in Table 2.

Table 2 Pollution Degree Ratings According to EN 61800-5-1

Pollution Degree	Description
1	No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
2	Normally, only non-conductive pollution occurs. Occasionally, however, a temporary conductivity caused by condensation is to be expected, when the drive is out of operation.
3	Conductive pollution or dry non-conductive pollution occurs, which becomes conductive due to condensation, which is to be expected.
4	The pollution generates persistent conductivity caused, for example by conductive dust or rain or snow.

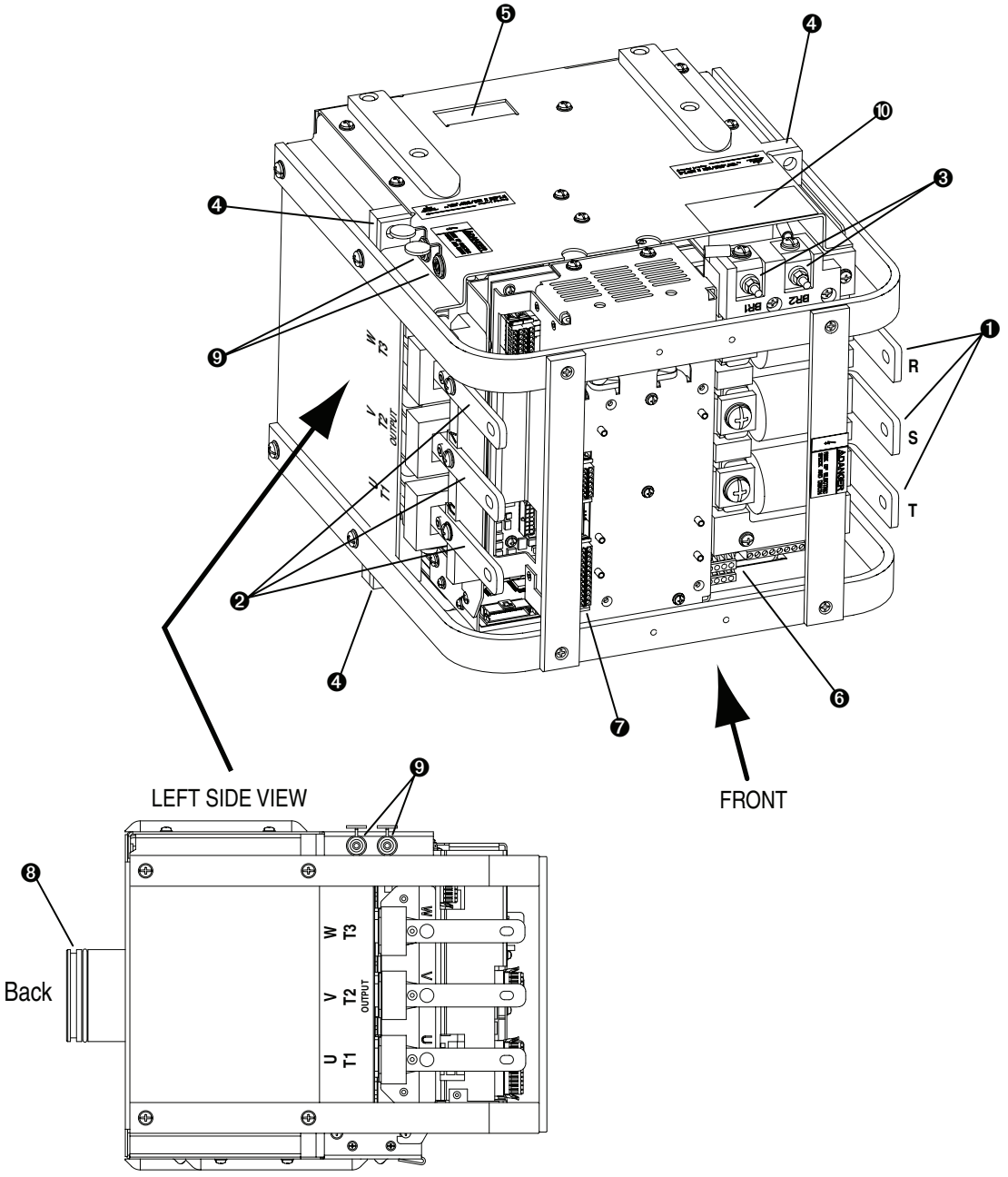
- The PowerFlex 700L Frame 1X drive must be installed in a supplementary enclosure to be CE compliant with respect to protection against electrical shock.
- The PowerFlex 700L Frame 1X drive produces touch current in the protective earthing conductor which exceeds 3.5 mA AC and/or 10 mA DC. The minimum size of the protective earthing (grounding) conductor used in the application must comply with local safety regulations for high protective earthing conductor current equipment.

Installation Requirements Related to EN 61800-3 and the EMC Directive

- The drive must be earthed (grounded) as described in these instructions (see General Grounding Requirements on page 18).
- Output power wiring to the motor must employ cable with a braided shield providing 75% or greater coverage, or the cables must be housed in metal conduit, or equivalent shielding must be provided. Continuous shielding must be provided from the drive enclosure to the motor enclosure. Both ends of the motor cable shield (or conduit) must terminate with a low-impedance connection to earth. At the drive end of the motor cable, the cable shield must be connected to the motor PE terminal on the drive.
- At the motor end of the motor cable, the cable shield or conduit must terminate in a shielded connector which must be properly installed in an earthed motor wiring box attached to the motor. The motor wiring box cover must be installed and earthed.
- All control (I/O) and signal wiring to the drive must use cable with a braided shield providing 75% or greater coverage, or the cables must be house in metal conduit, or equivalent shielding must be provided. When shielded cable is used, only the drive end of the cable shield should be terminated with a low-impedance connection to earth.
- Motor cabling must be separated from control and signal wiring wherever possible.
- Motor cable length must not exceed 5 m (16.4 ft) for compliance with radio frequency emission limits for compliance with the C3 limits of EN 61800-3 for I ≤100 A. Longer motor cables may be used if compliance with the C3 limits for I > 100 A is acceptable in the application. Longer motor cables may also be used if a supplementary EMC line filter is wired between the drive and the power supply.
- The drive must be powered from an earthed supply system such as a TN or TT system and the DC Bus Common Mode Caps (PE-B) and Input Filter Caps (PE-C) jumpers must be installed as described in Table 7 on page 22.

Component Locations

Figure 1 Frame 1X Drive Component Locations



Item	Component
❶	Input Power Terminal Connections
❷	Output Power Terminal Connections
❸	Brake Resistor Connections
❹	PE Grounds
❺	Access Point for Common Mode Capacitor and MOV Connections

Item	Component
❻	Main Control Board
❼	RTD PC Board
❽	Cooling Loop Connections
❾	DC+ and DC- Test Pt. Sockets
❿	Drive Data Nameplate

Step 2 Mount the Drive

Lifting

ATTENTION: To guard against possible personal injury and/or equipment damage...

- Do Not allow any part of the drive or lifting mechanism to make contact with electrically charged conductors or components.
- At no time should a person or their limbs be directly underneath the items being lifted.
- Do not subject the load to high rates of acceleration or deceleration.
- Inspect all lifting hardware for proper attachment before lifting drive unit.

Refer to Figure 2 and Figure 3 for lifting information.

Figure 2 Drive Weight and Lifting Orientation

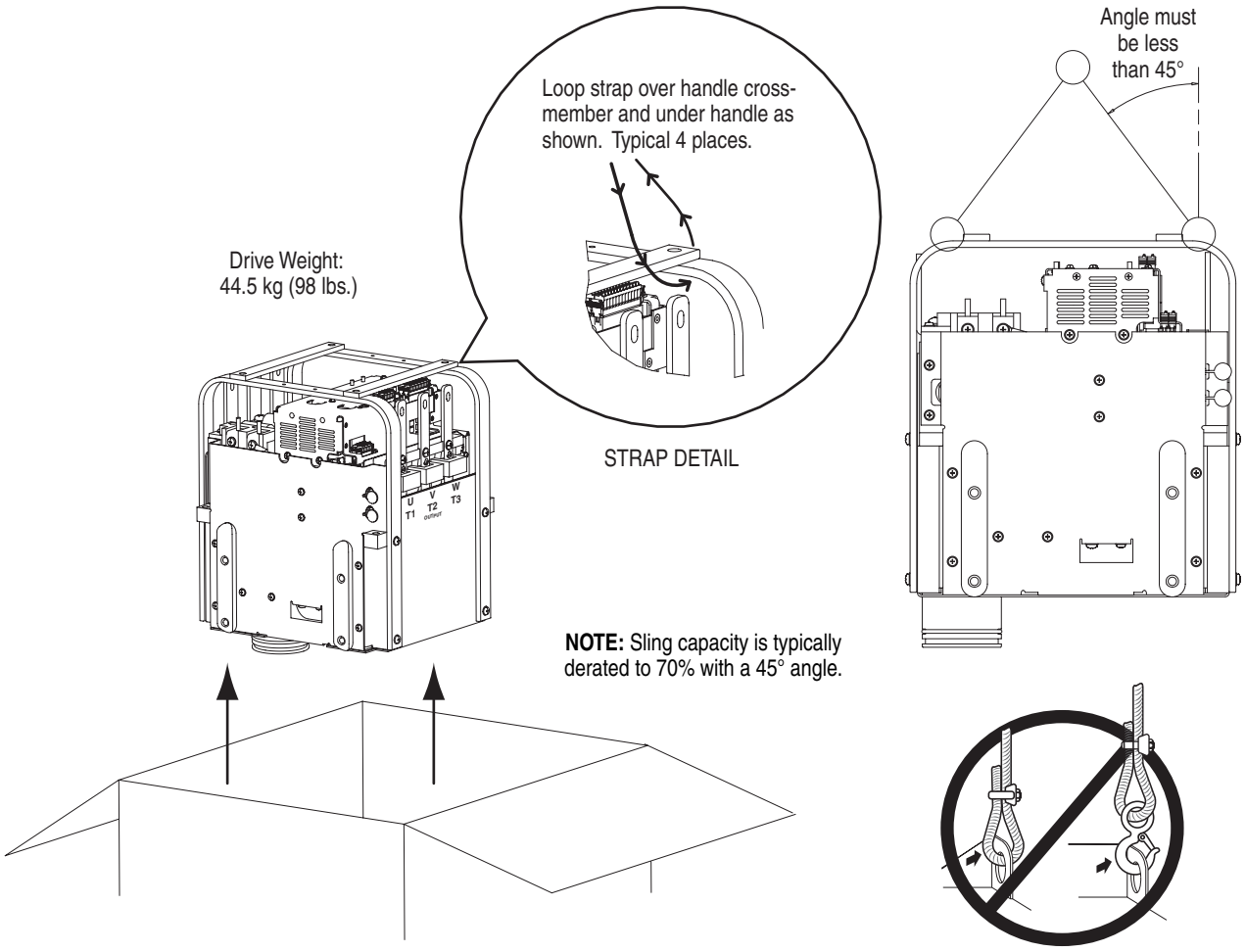
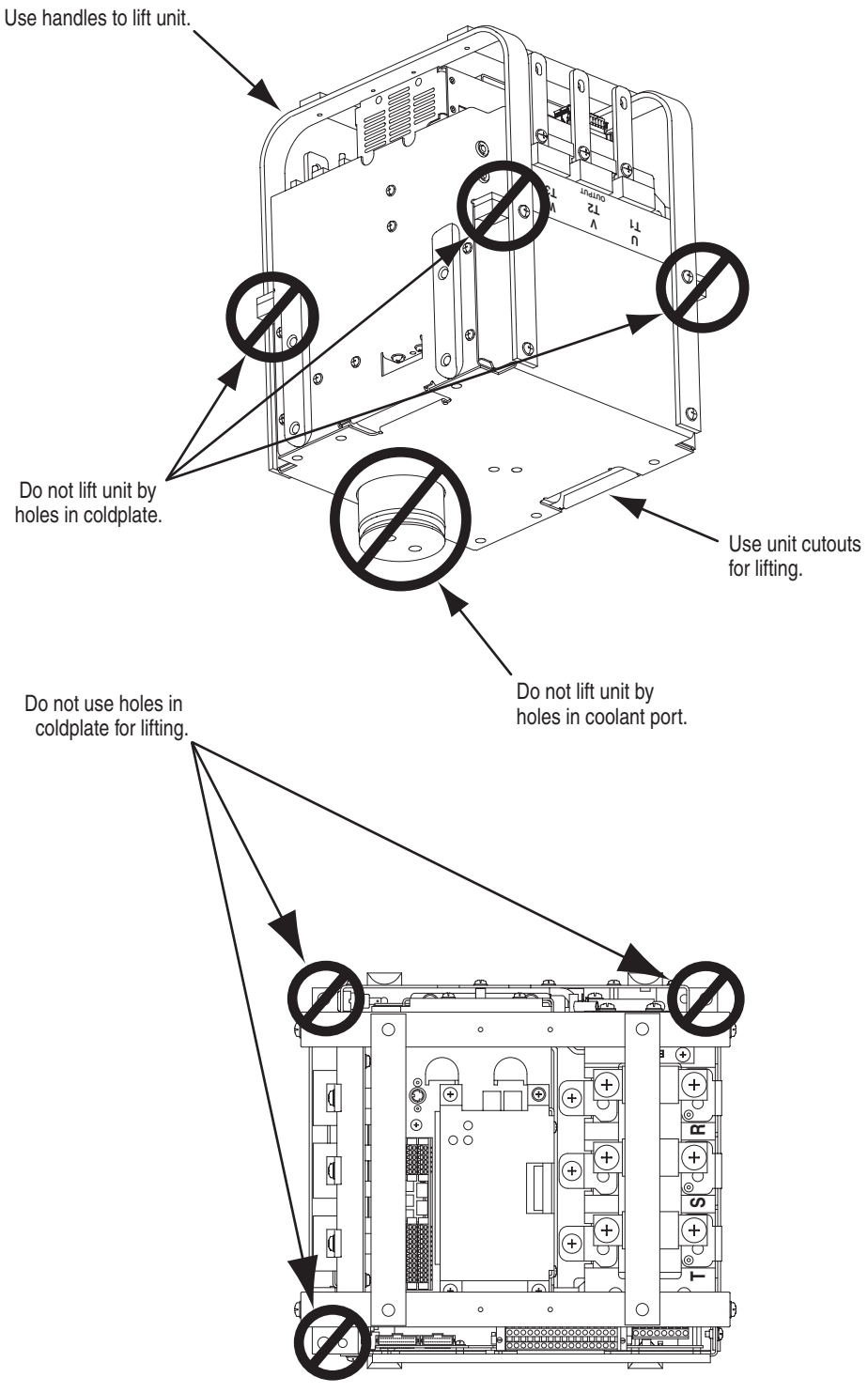


Figure 3 Lifting Details



Mounting Considerations

This drive is intended to be installed in an enclosure by sliding it in on the white Teflon® sliders. These sliders should slide into rails inside the enclosure so that the drive cannot move from side to side.

Operating Temperatures

PowerFlex 700L Frame 1X drives are designed to operate at -10…60 °C (14…140 °F) ambient.

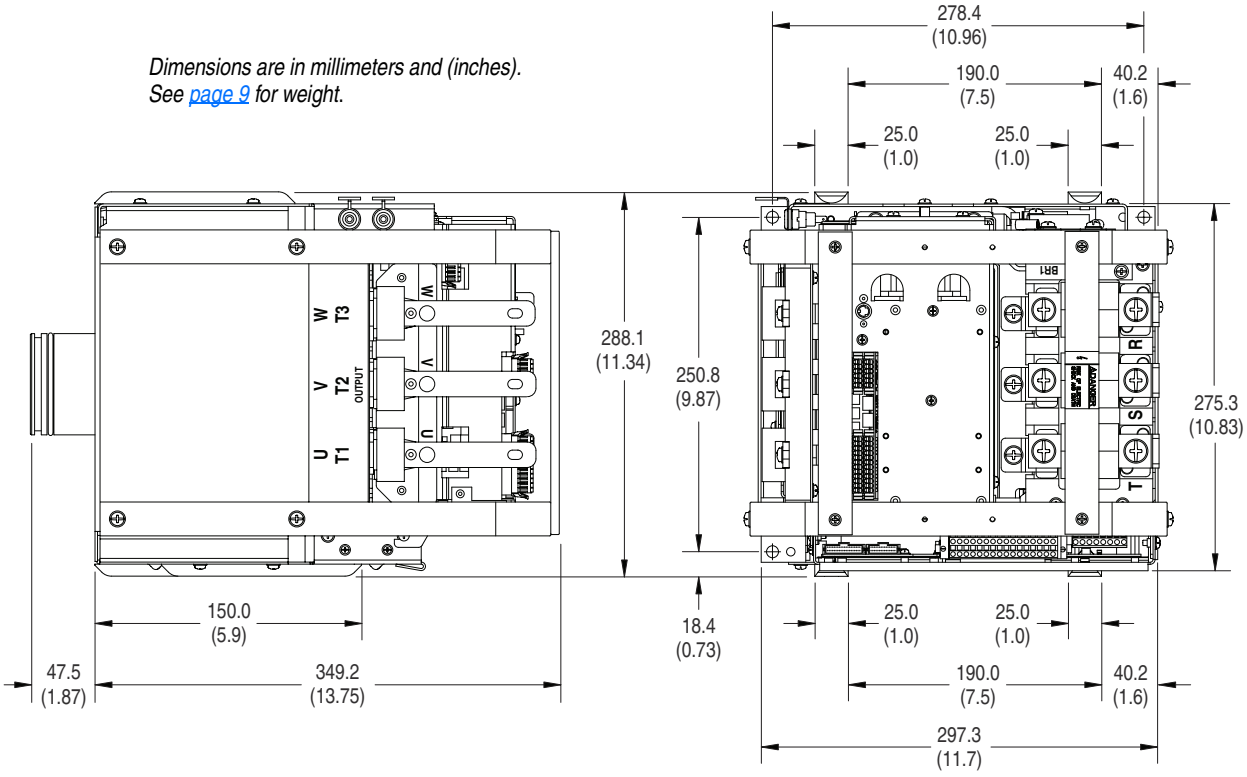
Minimum Mounting Clearances and Heat Dissipation

There is no minimum mounting clearance required for the drive to dissipate heat. However, ensure that there is sufficient space in the front for routing cables and in the rear for connecting the coolant lines. Multiple drives can be mounted in an enclosure with no minimum side-to-side clearance between the drives and the enclosure walls.

Dimensions

Figure 4 Frame 1X Drive Dimensions

Dimensions are in millimeters and (inches).
See page 9 for weight.



FRONT VIEW

Step 3 Connect the Cooling Loop

Drive Coolant Requirements

Recommended Coolants

Table 3 lists approved sources and recommended coolants with appropriate corrosion inhibitors for the drive loop:

Table 3 Recommended Drive Loop Coolants

Source	Coolant Description
Interstate Chemical http://www.interstatechemical.com/contact.htm	• NFP-50 (1), a 50/50 premix of propylene glycol and distilled water • NFE-50 (1), a 50/50 premix of ethylene glycol and distilled water
Koolant Koolers/Dimplex Thermal Solutions http://www.koolantkoolers.com/index.php/nic=contact	• K-Kool-E (1), ethylene glycol (available premixed with distilled water) • Propylene glycol (1) also available
Dow Chemical http://www.dow.com	• Dowtherm® SR-1 (2), ethylene glycol • Dowfrost® (2), propylene glycol Dowtherm and Dowfrost are registered trademarks of the Dow Chemical Company

(1) Available in 5 gallon containers.

(2) Not premixed with distilled water, and may not be available in 5 gallon quantities.

Non-premixed coolants require a coolant-to-water mix ratio of 50% by volume.

The estimated amount of coolant needed for Allen-Bradley 20L-LL* Liquid-to-Liquid Heat Exchangers is 15.1 liters (4 gal). This coolant estimate is based on the heat exchanger using 1.2 m (4 ft) hoses. Longer hoses require more coolant. The maximum hose length of 9.1 m (30 ft) would require up to an additional 2.8 liters (0.74 gal).

Important: Since coolant performance slowly degrades over time, the drive loop coolant should be replaced every two years and/or whenever the loop is drained for servicing.

Corrosion Inhibitor

If an approved coolant is not used, the drive coolant must consist of clean water *with a corrosion inhibitor.* An approved corrosion inhibitor is Chemtool, Inc. (www.chemtool.com) part number Watertool 4435-C. The recommended concentration of the inhibitor is 8-10% by volume. Deionized water is prohibited. Use distilled water or water with less than 50 ppm concentrations of:

- Sulfate and chloride
- Hard water ions such as Mg++ and Ca++

ATTENTION: Ethylene and propylene glycols must be inhibited and silicate free. **Use of common silicate-containing, automotive-type ethylene glycol solutions is prohibited as they may damage the heat exchanger and/or drive and cooling module equipment.**

The drive coolant must be compatible with the following materials:

- Copper
- Brass
- Aluminum
- Arimid fiber gasket with nitrile binder (Garlock, Inc. Blue-Gard 3000®)

  Blue-Gard 3000 is a registered trademark of Garlock, Inc.

- Synthetic rubber hose (Parker Hannifan Corp 801 General Purpose Hose)
- Viton seal (Complete Drive only)

Biocide

A biocide may be needed to control biological growth. Use of a biocide is permitted. For specific recommendations, consult a reputable water treatment company.

Drive Cooling Loop Specifications

Table 4 Coolant Requirements for One Frame 1X Drive

Coolant Temp. Range	Coolant Flow Rate		Max. Particle Size in Coolant	Pressure Drop (1) From Drive Inlet to Drive Outlet at Minimum Coolant Flow Rate	Coolant Type
	Minimum	Nominal			
0…60 °C (32…140 °F)	7.57 LPM (2 GPM)	9.46 LPM (2.5 GPM)	5 microns	Less than 0.34 bar at 9.46 LPM, 20 °C (Less than 5 psi at 2.5 GPM, 68 °F)	WEG50 (2) or WPG50 (3)

(1) Pressure drop does not include any system connections such as hoses or piping. Cooling systems must be sized to provide minimum flow considering entire system pressure drop.

(2) WEG50 equals good quality or distilled water with approved *inhibited** ethylene glycol, 50% glycol by volume.

(3) WPG50 equals good quality or distilled water with approved *inhibited** propylene glycol, 50% glycol by volume.

* Inhibited ethylene glycol or propylene glycol must contain a corrosion inhibitor. See Corrosion Inhibitor on page 12 for an approved source.

Cooling Loop Application Guidelines

ATTENTION: Risk of equipment damage exists. Do not use ferrous and plated-ferrous materials for pipe-treated water to the power modules and drive. Use of ferrous materials will degrade the performance of the power module chillplate.

The following section is intended to provide guidelines for applying cooling loops other than those recommended.

1. The allowable drive coolant temperature range is 0…60 °C (32…140 °F).

   When using coolant at a temperature below the dew point of the surrounding air, condensation could accumulate on the drive heatsink and/or circuit boards and damage the drive. In this situation, install a coolant flow regulating device and tube/hose insulation. A flow regulating device modulates the coolant flow rate to a level that permits the drive heatsink temperature to rise above the dew point. Insulation for customer side tube or hose may be closed-cell foam insulation with minimum 12.7 mm (0.50 in.) wall thickness.

2. The cooling loop should include a flow switch on the connection to the drive inlet to turn off the drive if coolant flow drops below the minimum flow required by the drive (see Table 4 on page 13).

3. Circulate coolant through the drive only when the drive is also powered. Failure to do this may result in condensation accumulating on the drive heatsink and/or circuit boards, which could damage the drive.

4. For applications requiring a closed loop coolant system, ensure the system is vented to remove air that would otherwise degrade the performance of the drive heatsink.

5. Install a flow measuring device at the inlet or outlet of each drive. The coolant flow rate (LPM or GPM) must meet the requirements in Table 4 on page 13.

6. The following types of pipe are recommended for cooling loop connections:

   - Copper tubing, type L
   - Brass pipe
   - Stainless steel, 300 series

   Important: Do not use galvanized pipe.

7. The cooling loop should have a method for draining and replacing the coolant.

Drive Coolant Connections

For locations of the coolant inlet and outlet connections on PowerFlex 700L Liquid-Cooled Frame 1X drives, refer to item 8 in Figure 1 on page 8.

The rated working pressure of the Frame 1X drive is 6.89 bar (100 psi). Coolant supply and return lines should be sized for 76 LPM (20 GPM) / 6.89 bar (100 psi) service with a maximum operating temperature of 60 °C (140 °F). The required operating flow rate and pressure drop is specified in Table 4 on page 13.

Coolant inlet and outlet connections are 1/4-inch NPT female. Apply Teflon thread sealing tape or pipe thread sealant to the threads of the coolant pipe that is being connected to the drive. Tighten to prevent leaks, but do not overtighten.

Step 4 Wire the Drive

ATTENTION: National Codes and standards (NEC, VDE, BSI etc.) and local codes outline provisions for safely installing electrical equipment. Installation must comply with specifications regarding wire types, conductor sizes, branch circuit protection and disconnect devices. Failure to do so may result in personal injury and/or equipment damage.

Special Considerations

The PowerFlex 700L Frame 1X drive is suitable for use on a circuit capable of delivering up to a maximum of 200,000 rms symmetrical amperes, 480 volts with recommended fuses/circuit breakers.

ATTENTION: To guard against personal injury and/or equipment damage caused by improper fusing or circuit breaker selection, use only the recommended line fuses/circuit breakers specified in Table 6 on page 20.

If a Residual Current Detector (RCD) is used as a system ground fault monitor, only Type B (adjustable) devices should be used to avoid nuisance tripping.

Unbalanced, Ungrounded, Impedance or Phase-Grounded Distribution Systems

If phase-to-ground voltage will exceed 125% of normal line-to-line voltage or the supply system is ungrounded, refer to *Wiring and Grounding Guidelines for PWM AC Drives* (publication DRIVES-IN001).

In addition, on an ungrounded distribution system where the line-to-ground voltages on any phase could exceed 125% of the nominal line-to-line voltage, an isolation transformer should be installed. See *Wiring and*

Grounding Guidelines for PWM AC Drives (publication DRIVES-IN001) for more information on impedance grounded and ungrounded systems.

ATTENTION: The PowerFlex 700L Frame 1X drive contains protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage, these devices must be disconnected if the drive is installed on an ungrounded, impedance or phase-grounded distribution system. See Table 7 on page 22 for recommended jumper configurations.

AC Line Reactor

There is no DC link reactor or AC input reactor built into the drive. Therefore, a 3% three-phase line reactor must be installed at the AC input terminals of the drive.

Recommended Reactors

Enclosure Type	Catalog Number
IP00 (Open Type)	1321-3R200-B
IP11 (NEMA/UL Type 1)	1321-3RA200-B

Input Power Conditioning

Certain events on the power system supplying a drive can cause component damage or shortened product life. These conditions include:

- The power system has power factor correction capacitors switched in and out of the system, either by the user or by the power company.
- The power source has intermittent voltage spikes in excess of 6000 volts. These spikes could be caused by other equipment on the line or by events such as lightning strikes.
- The power source has frequent interruptions.

Cable Trays and Conduit

If cable trays or large conduits are to be used, refer to the guidelines presented in the *Wiring and Grounding Guidelines for PWM AC Drives* (publication DRIVES-IN001).

ATTENTION: To avoid a possible shock hazard caused by induced voltages, unused wires in the conduit must be grounded at both ends. For the same reason, if a drive sharing a conduit is being serviced or installed, all drives using this conduit should be disabled. This will help minimize the possible shock hazard from “cross coupled” motor leads.

Motor Cable Lengths

Typically, motor lead lengths less than 91 meters (300 feet) are acceptable. However, if your application requires longer lengths, refer to the *Wiring and Grounding Guidelines for PWM AC Drives*, publication DRIVES-IN001.

Wire Recommendations

Type		Wire Type(s)	Description	Min. Insulation Rating
Power (1)(2)	Standard	600V, 90 °C (194 °F) XHHW2/RHW-2 Anixter B209500-B209507, Belden 29501-29507, or equivalent	• Four tinned copper conductors with XLPE insulation. • Copper braid/aluminum foil combination shield and tinned copper drain wire. • PVC jacket.	
Signal (1) (3) (4)	Standard Analog I/O	Belden 8760/9460 (or equivalent)	0.750 mm^2 (18 AWG), twisted pair, 100% shield with drain.	300V, 75…90 °C (167…194 °F)
		Belden 8770 (or equivalent)	0.750 mm^2 (18 AWG), 3 conductor, shielded for remote pot only.	
	Encoder/Pulse I/O: <30 m (100 ft.)	Combined: Belden 9730 (5)	0.196 mm^2 (24 AWG)	
	Encoder/Pulse I/O: 30…152 m (100…500 ft.)	Signal: Belden 9730/9728 (5)	0.196 mm^2 (24 AWG)	
		Power: Belden 8790 (6)	0.750 mm^2 (18 AWG)	
		Combined: Belden 9892 (7)	0.330 mm^2 (18 AWG), power is 0.500 mm^2 (20 AWG)	
	Encoder/Pulse I/O: 152…259 m (500…850 ft.)	Signal: Belden 9730/9728 (5)	0.196 mm^2 (24 AWG)	
		Power: Belden 8790 (6)	0.750 mm^2 (18 AWG)	
		Combined: Belden 9773/9774 (8)	0.750 mm^2 (18 AWG)	
Digital I/O (1) (3) (4)	Shielded	Multi-conductor shielded cable such as Belden 8770 (or equivalent)	0.750 mm^2 (18 AWG), 3 conductor, shielded.	300V, 60 °C (140 °F)

(1) Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

(2) The use of shielded wire for AC input power may not be necessary but is always recommended.

(3) If the wires are short and contained within a cabinet which has no sensitive circuits, the use of shielded wire may not be necessary, but is always recommended.

(4) I/O terminals labeled "(–)" or "Common" are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

(5) Belden 9730 is 3 individually shielded pairs (2 channel + power). If 3 channel is required, use Belden 9728.

(6) Belden 8790 is 1 shielded pair.

(7) Belden 9892 is 3 individually shielded pairs (3 channel) + 1 shielded pair for power.

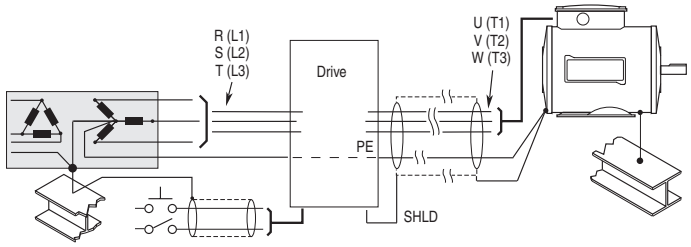
(8) Belden 9773 is 3 individually shielded pairs (2 channel + power). If 3 channel is required, use Belden 9774.

General Grounding Requirements

The drive Safety Ground - PE must be connected to system ground. Ground impedance must conform to the requirements of national and local industrial safety regulations and/or electrical codes. The integrity of all ground connections should be periodically checked.

For installations within a cabinet, a single safety ground point or ground bus bar connected directly to building steel should be used. All circuits including the AC input ground conductor should be grounded independently and directly to this point/bar.

Figure 5 Typical Grounding



Safety Ground - PE

This is the safety ground for the drive that is required by code. This point must be connected to adjacent building steel (girder, joist), a floor ground rod or bus bar (see above). Grounding points must comply with national and local industrial safety regulations and/or electrical codes.

Shield Termination

The Shield terminal (PE) provides a grounding point for the motor cable shield. The **motor cable** shield should be connected to this terminal on the drive (drive end) and the motor frame (motor end). A shield terminating cable gland may also be used.

When shielded cable is used for **control and signal wiring**, the shield should be grounded at the source end only, not at the drive end.

RFI Filter Grounding

Using an RFI filter (user supplied) may result in relatively high ground leakage currents. Therefore, any **filter must only be used in installations with grounded AC supply systems and be permanently installed and solidly grounded** (bonded) to the building power distribution ground. Ensure that the incoming supply neutral is solidly connected (bonded) to the same building power distribution ground. Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection. Some local codes may require redundant ground connections. The integrity of all connections should be periodically checked. Refer to the instructions supplied with the filter.

Power Wiring

Figure 6 Power Terminal Locations

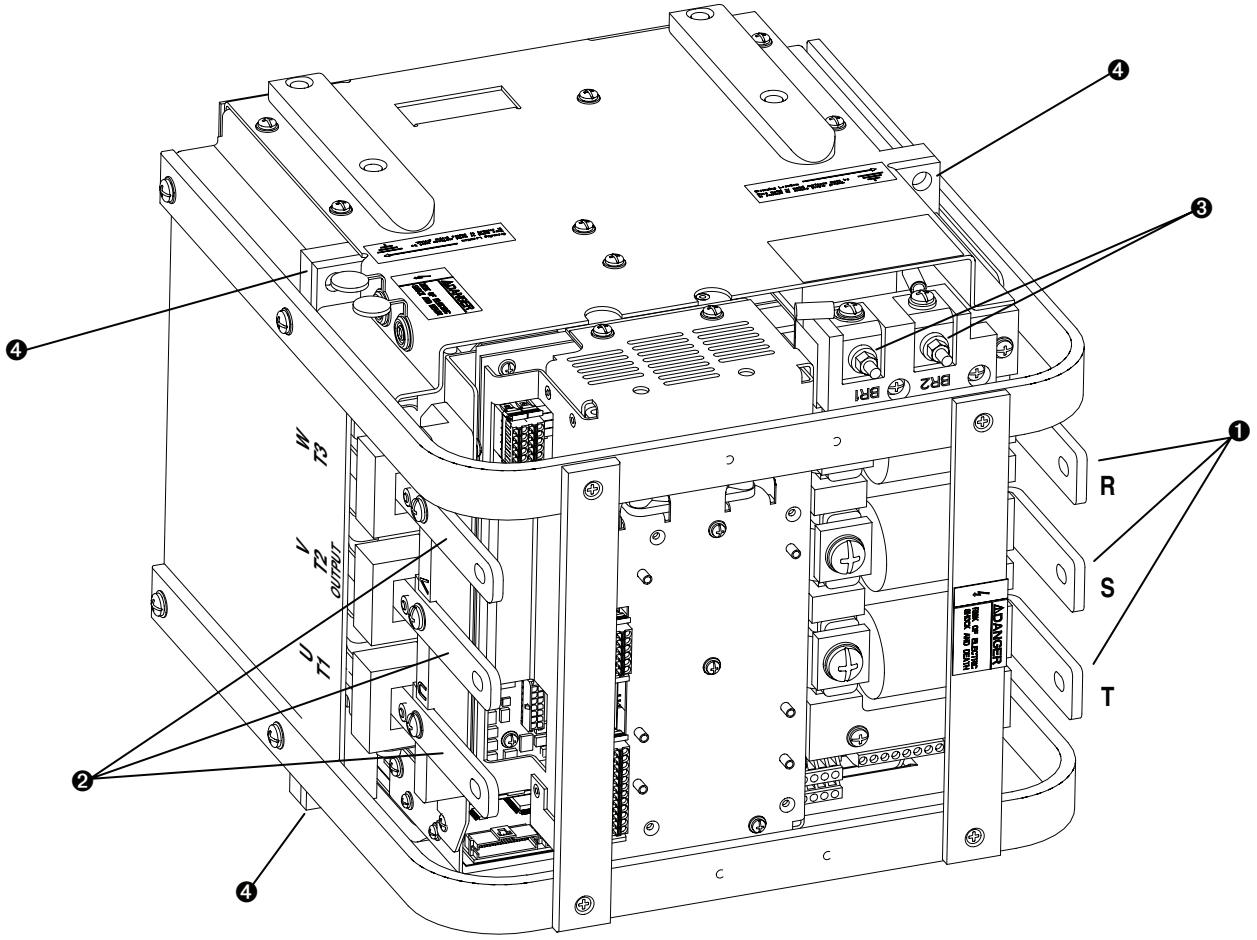


Table 5 Power Terminal Specifications

Item	Name	Description	Wire Size Range[1]		Recommended Torque (±10%)	Terminal Bolt Size
			Maximum	Minimum		
❶	Input Power	R (L1), S (L2), and T (L3) connections	70 mm^2 (2/0 AWG)	50 mm^2 (1 AWG)	7.9 N•m (70 lb•in)	M6
❷	Output Power	U (T1), V (T2), and W (T3) connections	70 mm^2 (2/0 AWG)	50 mm^2 (1 AWG)	3.95 N•m (35 lb•in)	M5
❸	Brake Resistor	BR1 (DC Brake +) and BR2 (DC Brake -) connections	35 mm^2 (2 AWG)	25 mm^2 (4 AWG)	3.95 N•m (35 lb•in)	M5
❹	Ground	PE and motor ground connections	70 mm^2 (2/0 AWG)	50 mm^2 (1 AWG)	7.9 N•m (70 lb•in)	M6

(1) Maximum/minimum sizes that the terminal block will accept - these are not recommendations.

Drive, Fuse, and Circuit Breaker Ratings

The PowerFlex 700L Frame 1X drive includes input fuses. National and local industrial safety regulations and/or electrical codes may determine additional requirements for these installations. Refer to Table 6 for recommended fuses/circuit breakers.

ATTENTION: The PowerFlex 700L Frame 1X drive does not provide branch short circuit protection. Specifications for the recommended fuse or circuit breaker to provide protection against short circuits are provided in Table 6.

Table 6 provides drive ratings (including continuous, 1 minute and 3 second) and recommended AC line input fuse and circuit breaker information. Both types of short circuit protection are acceptable for UL and IEC requirements. Sizes listed are the recommended sizes based on 40 °C and the U.S. NEC. Other country, state or local codes may require different ratings.

Fusing

If fuses are chosen as the desired protection method, refer to the recommended types listed below. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

- IEC – BS88 (British Standard) Parts 1 & 2(1), EN60269-1, Parts 1 & 2, type gG or equivalent should be used.
- UL – UL Class CC, T, RK1 or J must be used.

Circuit Breakers

The "non-fuse" listings in the following tables include both circuit breakers (inverse time or instantaneous trip) and 140M Self-Protecting Motor Starters. **If one of these is chosen as the desired protection method**, the following requirements apply.

- IEC and UL – Both types of devices are acceptable for IEC and UL installations.

Table 6 480 Volt AC Input Protection Devices

Drive Catalog Number	HP Rating		PWM Freq.	Temp.	Input Ratings	Output Amps			Dual Element Time Delay Fuse		Non-Time Delay Fuse		Circuit Breaker (3)	Motor Circuit Protector (4)
	ND	*HD*	*kHz*	*°C*	*Amps*	*Cont.*	*1 Min.*	*3 Sec.*	*Min. (1)*	*Max. (2)*	*Min. (1)*	*Max. (2)*	*Maximum*	*Maximum*
480 Volt AC Input														
CNMD180W0ENNNC1	150	—	4	50	169	180	198	270	225	400	225	600	500	250
	—	125	4	50	147	156	234	312	200	350	200	600	450	250

(1) *Minimum protection device size is the lowest rated device that supplies maximum protection without nuisance tripping.*
(2) *Maximum protection device size is the highest rated device that supplies drive protection. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.*
(3) Circuit Breaker - inverse time breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.
(4) Motor Circuit Protector - instantaneous trip circuit breaker. For US NEC, minimum size is 125% of motor FLA. Ratings shown are maximum.

(1) Typical designations include, but may not be limited to the following; Parts 1 & 2: AC, AD, BC, BD, CD, DD, ED, EFS, EF, FF, FG, GF, GG, GH.

Using Input/Output Contactors

Input Contactor Precautions

ATTENTION: A contactor or other device that routinely disconnects and reapplies the AC line to the drive to start and stop the motor can cause drive hardware damage. The drive is designed to use control input signals that will start and stop the motor. If an input device is used, operation must not exceed one cycle per minute or drive damage will occur.

ATTENTION: The drive start/stop/enable control circuitry includes solid state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit may be required to remove the AC line to the drive. An auxiliary braking method may be required.

Output Contactor Precaution

ATTENTION: To guard against drive damage when using output contactors, the following information must be read and understood. One or more output contactors may be installed between the drive and motor(s) for the purpose of disconnecting or isolating certain motors/loads. If a contactor is opened while the drive is operating, power will be removed from the respective motor, but the drive will continue to produce voltage at the output terminals. In addition, reconnecting a motor to an active drive (by closing the contactor) could produce excessive current that may cause the drive to fault. If any of these conditions are determined to be undesirable or unsafe, an auxiliary contact on the output contactor should be wired to a drive digital input that is programmed as "Enable." This will cause the drive to execute a coast-to-stop (cease output) whenever an output contactor is opened.

Bypass Contactor Precaution

ATTENTION: An incorrectly applied or installed bypass system can result in component damage or reduction in product life. The most common causes are:

- Wiring AC line to drive output or control terminals.
- Improper bypass or output circuits not approved by Allen-Bradley.
- Output circuits which do not connect directly to the motor.

Contact Allen-Bradley for assistance with application or wiring.

Disconnecting MOVs and Common Mode Capacitors

The PowerFlex 700L Frame 1X drive contains protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage and/or operation problems, these devices must be properly configured according to Table 7.

Figure 7 MOV and AC EMI Capacitor Phase to Ground

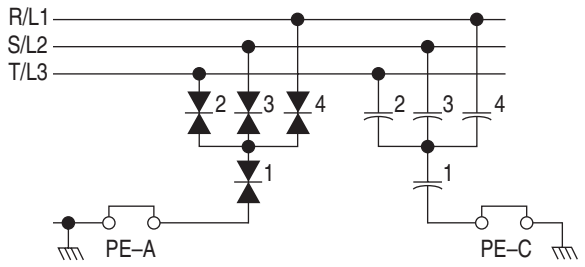
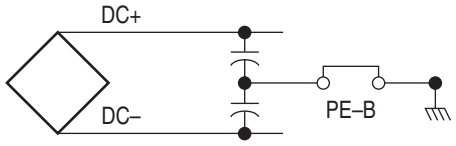


Figure 8 Common Mode Capacitors to Ground



ATTENTION: The PowerFlex 700L Frame 1X drive contains protective MOVs and common mode capacitors that are referenced to ground. To guard against drive damage, these devices must be disconnected if the drive is installed on an ungrounded, impedance or phase-grounded distribution system. See Table 7 for recommended jumper configurations.

ATTENTION: PE-A, PE-B, and PE-C jumpers must be configured according to the recommendations in Table 7. The PE-D and PE-E power jumpers must always remain connected.

Table 7 Recommended Power Jumper Configurations

Power Source Type [1]	MOV (PE-A) [2]	DC Bus Common Mode Caps (PE-B)	Input Filter Caps (PE-C)	Bridge Circuit Bd Gnd (PE-D)	RTD Circuit Bd Ground (PE-E)	Benefits Of Correct Configuration on Power Source Type
Unknown	Connected [3]	Disconnected [3]	Connected [3]	Connected [3]	Connected [3]	See below.
• AC fed Solidly Grounded • DC fed from passive rectifier which has a Solidly Grounded AC source	Connected	Connected	Connected			UL compliance, Reduced electrical noise, Most stable operation, EMC compliance, Reduced voltage stress on components and motor bearings
• AC fed Ungrounded • Impedance Grounded • DC fed from an active converter	Disconnected	Disconnected	Disconnected			Helps avoid severe equipment damage when ground fault occurs

[1] It is highly recommended to accurately determine the power source type and then configure appropriately.

[2] When MOVs are disconnected, the power system must have its own transient protection to insure known and controlled voltages.

[3] This is the factory default configuration. **NOTE:** The PE-D and PE-E power jumpers must be connected regardless of the power source type.

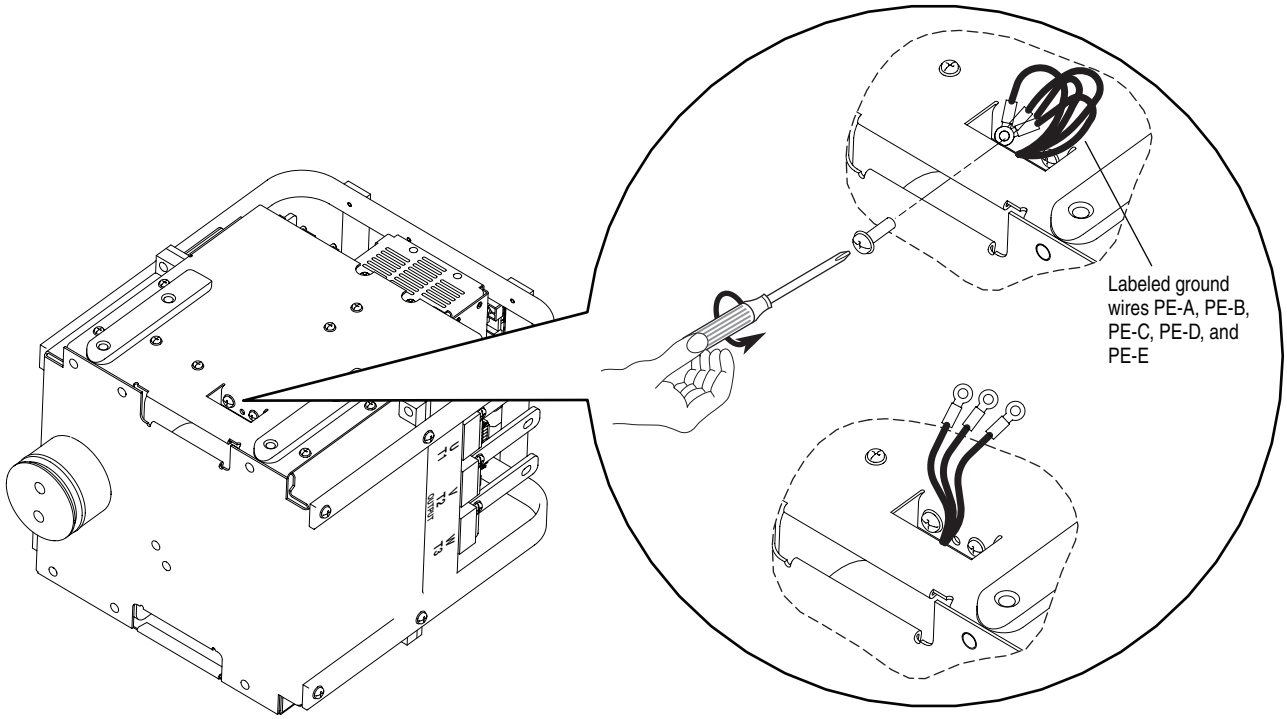
ATTENTION: To avoid an electric shock hazard, verify that the voltage on the bus capacitors has discharged before connecting/disconnecting the MOV, EMI Snubber Board, and common mode capacitor wires. Measure the DC bus voltage at the **DC+ and DC– Test Pt.** sockets on the drive (see item 9 in Figure 1 on page 8 for location). The voltage must be zero.

The power jumpers PE-A, PE-C, PE-D, and PE-E are factory connected to ground using one of the two screws shown in Figure 9. Jumpers PE-D and PE-E must remain connected.

To connect or disconnect the drive's protective MOVs and common mode capacitors, refer to Table 7 and Figure 9. Then:

1. Remove the appropriate screw(s) from the drive flange that connect the wire(s).
2. Cut the lugs off the ground wire(s) to be disconnected. Apply wire nuts to the end(s) of the disconnected wires.
3. Tie wrap the disconnected ground wires to keep them away from any electrical connections.
4. Gather together the wire lugs of the remaining ground wires to be connected. Using the screw(s), fasten the ground wires to the drive flange. Torque to 3.2 N•m (28 lb•in).
5. Tuck the wires back into the drive flange.

Figure 9 Protective Circuit Connections for Grounded Drive Distribution Systems



Step 5 I/O Wiring

Important points to remember about I/O wiring:

- Use Copper wire only. Wire gauge requirements and recommendations are based on 75 °C (167 °F). Do not reduce wire gauge when using higher temperature wire.
- Wire with an insulation rating of 600V or greater is recommended.
- Control and signal wires should be separated from power wires by at least 0.3 meters (1 foot).

Important: I/O terminals labeled "(–)" or "Common" are not referenced to earth ground and are designed to greatly reduce common mode interference. Grounding these terminals can cause signal noise.

ATTENTION: Configuring an analog input for 0…20 mA operation and driving it from a voltage source could cause component damage. Verify proper configuration prior to applying input signals.

ATTENTION: Hazard of personal injury or equipment damage exists when using bipolar input sources. Noise and drift in sensitive input circuits can cause unpredictable changes in motor speed and direction. Use speed command parameters to help reduce input source sensitivity.

I/O Terminals

Figure 10 shows the drive Main Control Board and its terminal block locations. The Main Control Board includes the drive control firmware, I/O terminal block, and optional encoder board.

Figure 10 Drive Main Control Board and I/O Control Terminal Blocks

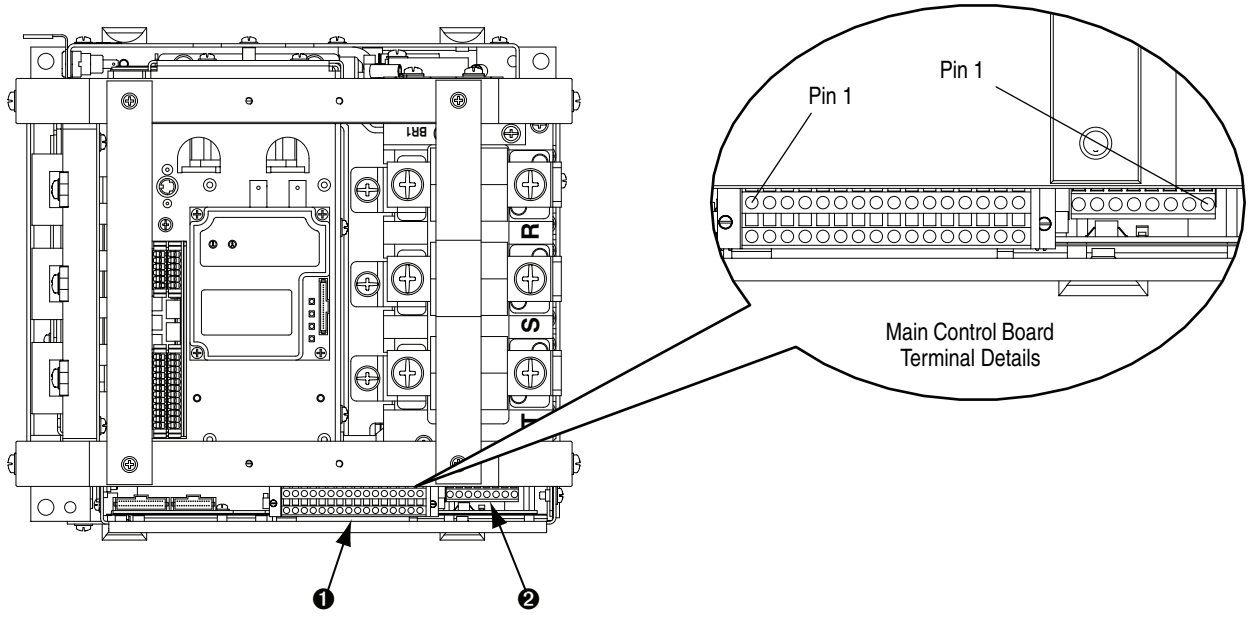
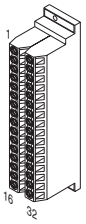


Table 8 I/O Terminal Block Specifications

No.	Name	Description	Wire Size Range[1]		Torque	
			Maximum	Minimum	Maximum	Recommended
❶	I/O Terminal Block	Signal and control connections	2.1 mm^2 (14 AWG)	0.30 mm^2 (22 AWG)	0.6 N•m (5.2 lb•in)	0.6 N•m (5.2 lb•in)
❷	Encoder (optional) Terminal Block	Encoder power and signal connections	0.75 mm^2 (18 AWG)	0.196 mm^2 (24 AWG)	0.6 N•m (5.2 lb•in)	0.6 N•m (5.2 lb•in)

(1) Maximum/minimum that the terminal block will accept - these are not recommendations.

Table 9 Vector Control Option I/O Terminal Designations



No.	Signal	Factory Default	Description	Related Parameters
1	Analog In 1 (–)[1]	[2]	Isolated[3], bipolar, differential, ±10V/ 0…20 mA, 11 bit and sign. For 0-20 mA, a jumper must be installed at terminals 17 and 18 (or 19 and 20). 88k ohm input impedance when configured for volt and 95.3 ohm for current	320… 327
2	Analog In 1 (+)[1]			
3	Analog In 2 (–)[1]			
4	Analog In 2 (+)[1]			
5	Pot Common	—	For (+) and (–) 10V pot references	
6	Analog Out 1 (–)	[2]	Single-ended bipolar (current output is not bipolar), ±10V/0…20 mA, 11 bit and sign, Voltage mode - limit current to 5 mA. Current mode - max. load is 400 ohms.	340…347
7	Analog Out 1 (+)			
8	Analog Out 2 (–)			
9	Analog Out 2 (+)			
10	HW PTC Input 1	—	1.8k ohm PTC, Internal 3.32k ohm pull-up resistor	238, 259
11	Digital Out 1 – N.C.[4]	Fault	Max. Resistive Load: 240V AC/30V DC – 1200VA, 150 W Max. Current: 5 A, Min. Load: 10 mA Max. Inductive Load: 240V AC/30V DC – 840VA, 105 W Max. Current: 3.5 A, Min. Load: 10 mA	380…391
12	Digital Out 1 Common			
13	Digital Out 1 – N.O.[4]	NOT Fault		
14	Digital Out 2 – N.C.[4]	NOT Run		
15	Digital Out 2/3 Com.			
16	Digital Out 3 – N.O.[4]	Run		
17	Current In Jumper [1] – Analog In 1		Placing a jumper across terminals 17 and 18 (or 19 and 20) will configure that analog input for current.	320…327
18				
19	Current In Jumper [1] – Analog In 2			
20				
21	–10V DC Pot Ref.	—	2k ohm minimum load	
22	+10V DC Pot Ref.	—		
23	HW PTC Input 2	—	See above	
24	+24V DC [5]	—	Drive-supplied logic input power[5]	
25	Digital In Common	—		
26	24V Common[5]	—	Common for internal power supply	
27	Digital In 1[6]	Stop - CF	115V AC, 50/60 Hz - Opto isolated Low State: less than 30V AC High State: greater than 100V AC, 5.7 mA 24V DC - Opto isolated Low State: less than 5V DC High State: greater than 20V DC, 10 mA DC Digital Input Impedance: 21k ohm	361…366
28	Digital In 2[6]	Start		
29	Digital In 3 [6]	Auto/Man.		
30	Digital In 4 [6]	Speed Sel 1		
31	Digital In 5 [6]	Speed Sel 2		
32	Digital In 6/Hardware Enable [6], see page 30	Speed Sel 3		

(1) **Important:** 0…20 mA operation requires a jumper at terminals 17 and 18 (or 19 and 20). Drive damage may occur if jumper is not installed.

(2) These inputs/outputs are dependant on a number of parameters (see “Related Parameters”).

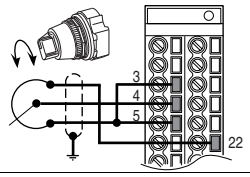
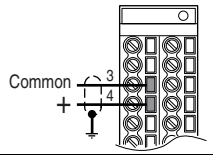
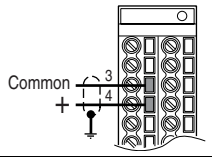
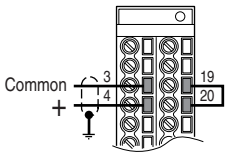
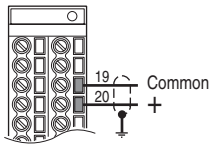
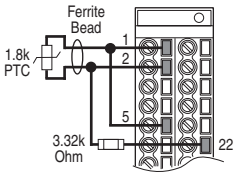
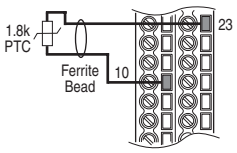
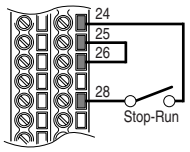
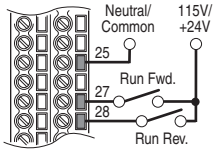
(3) Differential Isolation - External source must be maintained at less than 160V with respect to PE. Input provides high common mode immunity.

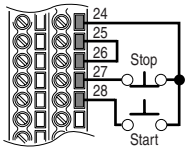
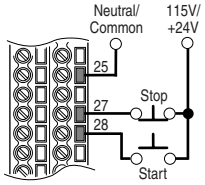
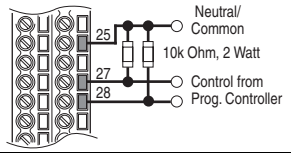
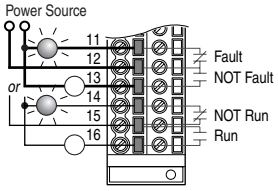
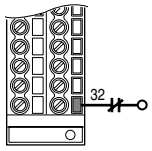
(4) Contacts in unpowered state. Any relay programmed as Fault or Alarm will energize (pick up) when power is applied to drive and deenergize (drop out) when a fault or alarm exists. Relays selected for other functions will energize only when that condition exists and will deenergize when condition is removed.

(5) 150 mA maximum load designed to power digital inputs only. Not present on 115V versions.

(6) A 10k ohm, 2 watt burden resistor must be installed on each digital input when using a triac type device. The resistor is installed between each digital input and neutral/common.

I/O Wiring Examples

Input/Output	Connection Example	Required Parameter Changes
Potentiometer Unipolar Speed Reference (1) 10k Ohm Pot. Recommended (2k Ohm Minimum)		• Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Input Bipolar Speed Reference ±10V Input		• Set Direction Mode: Parameter 190 = "1" (Bipolar) • Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Voltage Input Unipolar Speed Reference 0…10V Input		• Configure Input with Parameter 320 • Adjust Scaling: Parameters 91/92 and 325/326 • View results: Parameter 002
Analog Current Input Unipolar Speed Reference **Vector** 0…20 mA Input		• Configure Input for Current: Parameter 320 and add jumper at appropriate terminals • Adjust Scaling: Parameters 91/92 and 325/326 • View results: Parameter 002
Analog Current Input Unipolar Speed Reference **Standard** 4…20 mA Input		• Configure Input for Current: Parameter 320, bit 1 = "Current" • Adjust Scaling: Parameters 91/92 and 325/326 • View Results: Parameter 002
Analog Input, PTC **Vector** PTC OT set > 5V PTC OT cleared < 4V PTC Short < 0.2V		• Set Fault Config 1: Parameter 238, bit 7 = "Enabled" • Set Alarm Config 1: Parameter 259, bit 11 = "Enabled" • View Status Drive Alarm 1: Parameter 211, bit 11 = "True"
HW PTC Input (2) PTC OT set > 5V PTC OT cleared < 4V PTC Short < 0.2V		• Set Fault Config 1: Parameter 238, bit 13 = "Enabled" • Set Alarm Config 1: Parameter 259, bit 18 = "Enabled" • View Status: Drive Alarm 1: Parameter 211, bit 18 = "True"
2-Wire Control Non-Reversing (3) 24V DC internal supply		• Disable Digital Input #1: Parameter 361 = "0" (Not Used) • Set Digital Input #2: Parameter 362 = "7" (Run) • Set Direction Mode: Parameter 190 = "0" (Unipolar)
2-Wire Control Reversing (3) External supply (I/O Board dependent)		• Set Digital Input #1: Parameter 361 = "8" (Run Forward) • Set Digital Input #2: Parameter 362 = "9" (Run Reverse)

Input/Output	Connection Example	Required Parameter Changes
3-Wire Control Internal supply		• No changes required if parameters are at factory default settings
3-Wire Control External supply (I/O Board dependent). Requires 3-wire functions only ([Digital In1 Sel]). Using 2-wire selections will cause a type 2 alarm.		• No changes required if parameters are at factory default settings
Digital Input PLC Output Card (Board dependent). Resistors are recommended to dissipate leakage current.		• No changes required if parameters are at factory default settings
Digital Output Relays shown in powered state with drive faulted. See Table 9. Vector Control: 2 relays at terminal 14…16 Standard Control: 1 relay at terminals 14…16		Vector Control: • Select Source to Activate: Parameters 380/384/388 Standard Control: • Select Source to Activate: Parameters 380/384
Enable Input		Vector Control • Configure with Parameter 366. For dedicated hardware Enable: Remove Jumper J10 (see page 30) Standard Control: • Configure with Parameter 366

(1) Refer to the Attention statements on page 24 for important bipolar wiring information.

(2) A PTC (Positive Temperature Coefficient) device (motor thermistor), embedded in the motor windings, can be monitored by the drive for motor thermal protection.

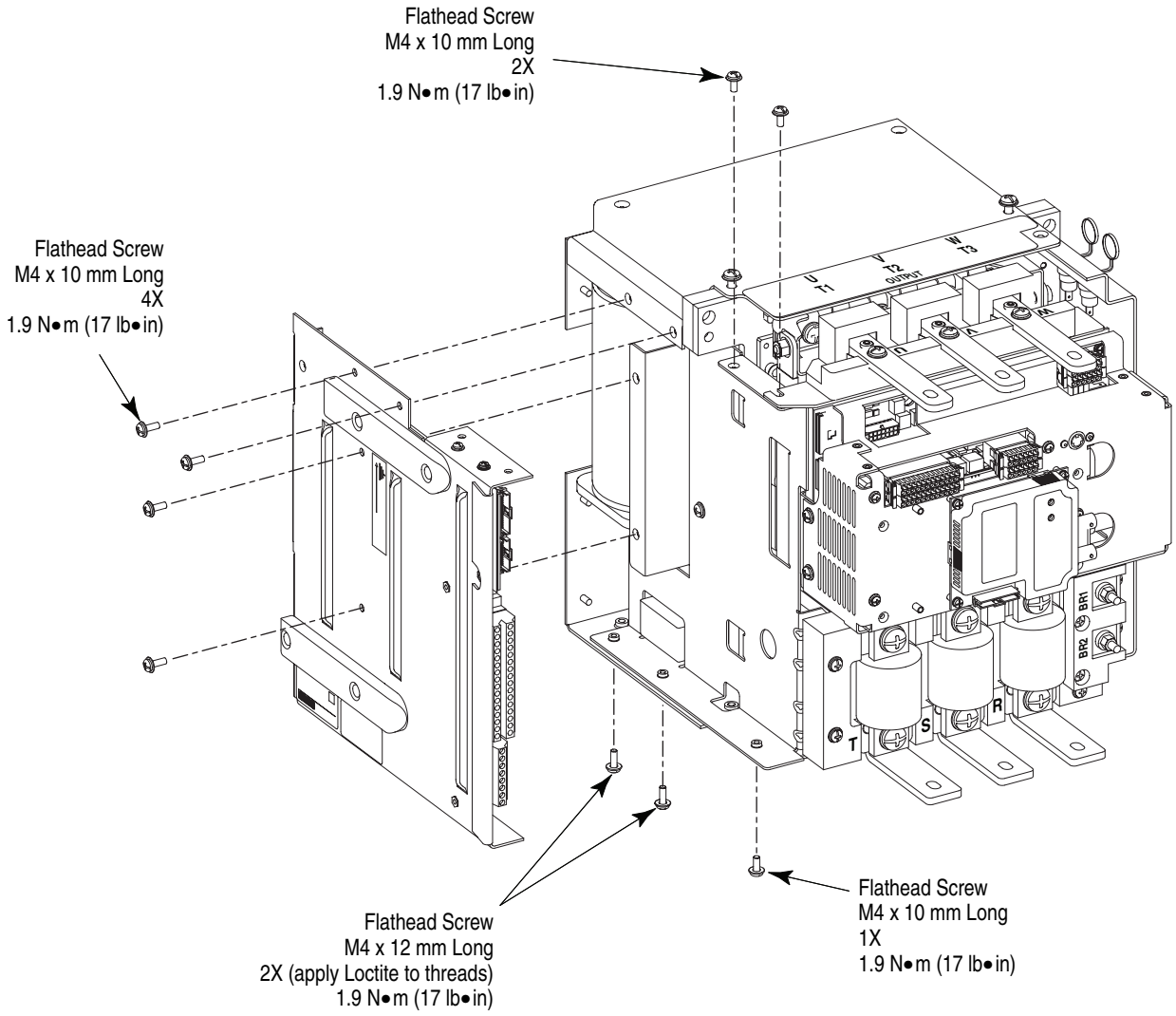
(3) **Important:** Programming inputs for 2 wire control (Run) deactivates all HIM Start buttons unless Parameter 192 [Save HIM Ref], bit 1 (Manual Mode) = "1." This will allow the HIM to control Start and Jog.

Hardware Enable Circuitry (Vector Control Only)

By default, the user can program a digital input as an Enable input. The status of this input is *interpreted by drive software*. If the application requires the drive to be disabled *without* software interpretation, a "dedicated" hardware enable configuration can be used. This is done by removing a jumper and wiring the enable input to "Digital In 6."

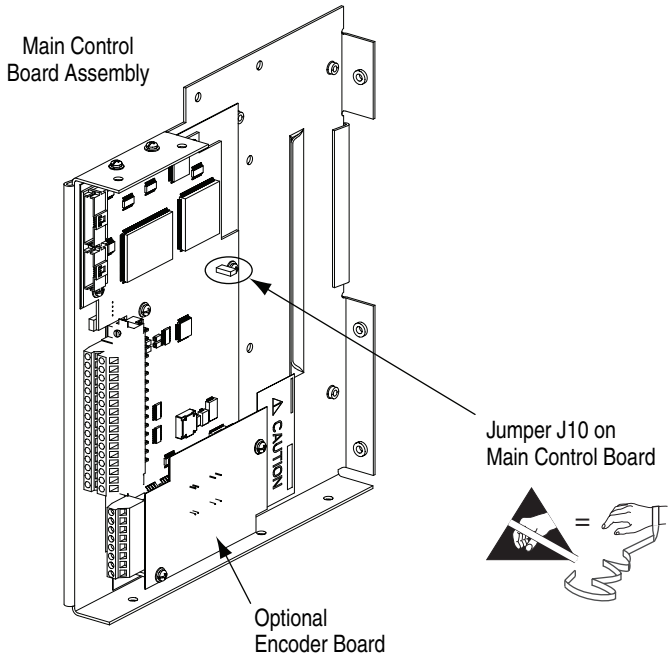
1. Remove the drive Main Control Board (see Figure 11).

Figure 11 Main Control Board Removal



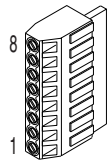
2. Locate and remove Jumper J10 on the Main Control Board (see Figure 12).
3. Re-install the Main Control Board into the drive.
4. Wire Enable to “Digital In 6” (see page 26).
5. Verify that [Digital In6 Sel], Parameter 366 is set to “1” (Enable).

Figure 12 Hardware Enable Jumper Location



Encoder Interface Option (Vector Control Only)

Table 10 Encoder Terminal Designations

	No.	Description	
See "Detail" in Figure 10 	8	+12V (1) DC Power	Internal power source 250 mA.
	7	+12V (1) DC Return (Common)	
	6	Encoder Z (NOT)	Pulse, marker or registration input. (2)
	5	Encoder Z	
	4	Encoder B (NOT)	Quadrature B input.
	3	Encoder B	
	2	Encoder A (NOT)	Single channel or quadrature A input.
	1	Encoder A	

(1) Jumper selectable +5/12V is available on 20B-ENC-1 Encoder Boards.

(2) Z channel can be used as a pulse input while A and B are used for encoder.

Table 11 Encoder Specifications

Type:	Incremental, dual channel
Supply:	12V, 250 mA. 12V, 10 mA minimum inputs isolated with differential transmitter, 250 kHz maximum.
Quadrature:	90°, ±27° at 25 °C.
Duty Cycle:	50%, +10%
Requirements:	Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 8…15V DC output (3.5…6V DC when jumpers are in 5V position), single-ended or differential and capable of supplying a minimum of 10 mA per channel. Maximum input frequency is 250 kHz. The Encoder Interface Board accepts 12V DC square-wave with a minimum high state voltage of 7.0V DC. With the jumpers in the 5V position, the encoder will accept a 5V DC square-wave with a minimum high state voltage of 3.1V DC. In either jumper position, the maximum low state voltage is 0.4V DC.

Figure 13 Encoder Board Jumper Settings

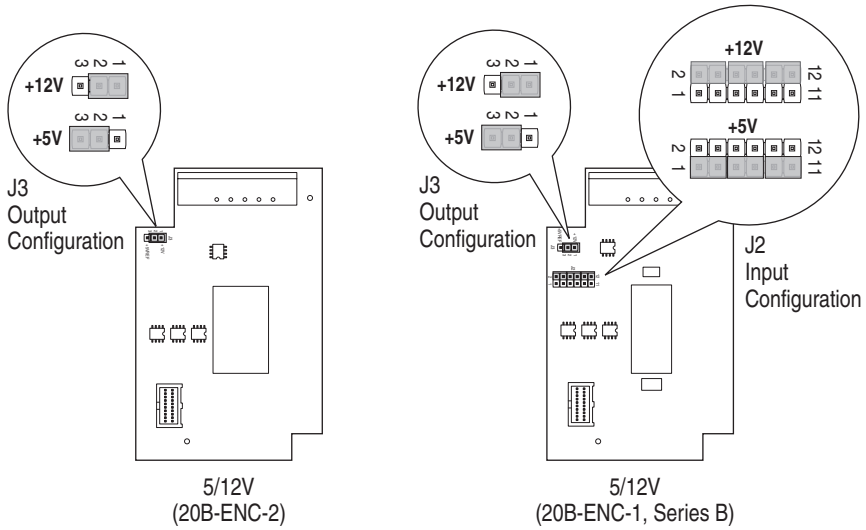
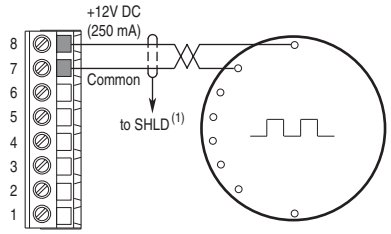
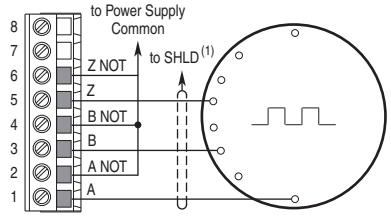
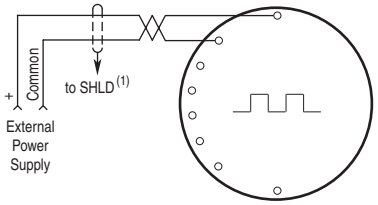
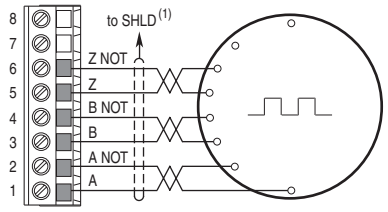


Figure 14 Sample Encoder Wiring

I/O	Connection Example
Encoder Power – Internal Drive Power Internal (drive) 12V DC, 250 mA (1)	
Encoder Signal – Single-Ended, Dual Channel (2)	
Encoder Power – External Power Source	
Encoder Signal – Differential, Dual Channel	

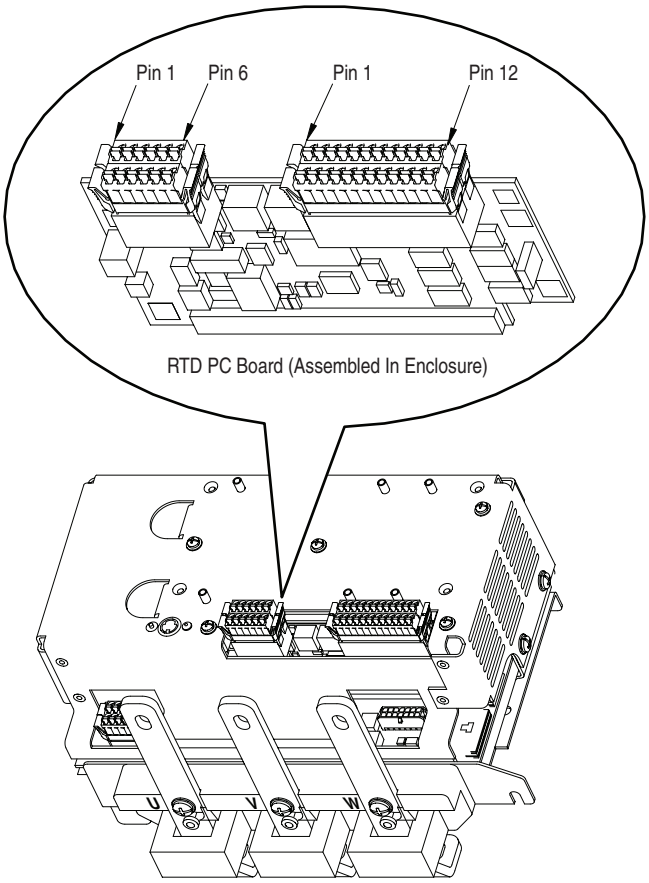
(1) SHLD connection is on the drive chassis (item 4 in Figure 6 on page 19)

(2) Example applies to 20B-ENC-1 only.

Resistance Temperature Detector (RTD) Board

Up to eight RTD or NTC (negative temperature coefficient) temperature sensors are supported by the RTD board in the PowerFlex 700L Frame 1X drive. The number of I/O connections required from an upper level controller to use the RTD board can be managed by selecting one of several configuration options.

Figure 15 RTD Board Location



Connections

Figure 16 RTD Board Connections

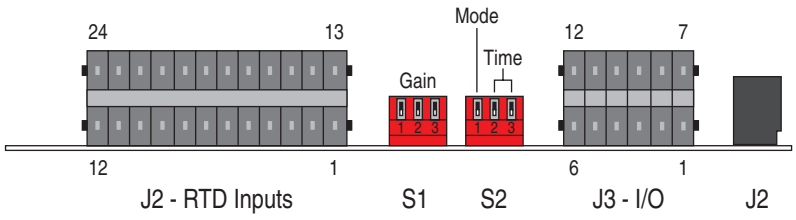


Table 12 J2 RTD Board I/O Function Settings

J2 Position	I/O Function
1	+24V COM
2	LOUT1 COM
3	LOUT2 COM
4	LOUT3 COM
5	LIN COM
6	AOUT COM
7	+24VDC
8	LOUT1 NO
9	LOUT2 NO
10	LOUT3 NO
11	LIN
12	AOUT

Important: A motor temperature sensor (RTD, NTC or thermocouple) should be considered equivalent to a motor thermostat and wired with the same considerations. Motor thermostat contacts are generally not isolated from the drive/controller digital inputs. Therefore, the sensor inputs will not be isolated on the RTD board.

Hardware

The hardware consists of a single PC board with two wired connectors, one for temperature sensors and the second for power and I/O signals.

RTD/NTC Sourcing

A 2-wire RTD or NTC temperature sensor may be used. A chassis connection is available for each sensor for use with shielded cable. Each channel requires up to three connections.

Multiplexer and Amplifier

An analog multiplexer sequentially connects the temperature sensors one at a time to the analog output. The active sensor channel is indicated by a 3-bit output (A0…A2). When using an RTD or NTC, a simple voltage divider is formed and the device is probed differentially.

The sensor voltages are amplified using a high-quality, rail-to-rail instrumentation amplifier with gain adjustment. To accommodate a variety of sensors and temperature ranges, an amplifier boosts the analog sensor voltage in order to increase the temperature resolution. Discrete gains of x10 through x80 are selectable through DIP switch settings. A 4th order low pass filter rejects normal-mode noise at the analog input with a cutoff frequency of approximately 16 Hz.

To determine the proper gain setting:

1. Determine R_{MAX}, the maximum resistance of the sensor over the temperature range to be measured.

2. Determine the maximum voltage across R_{MAX} using the following equation:

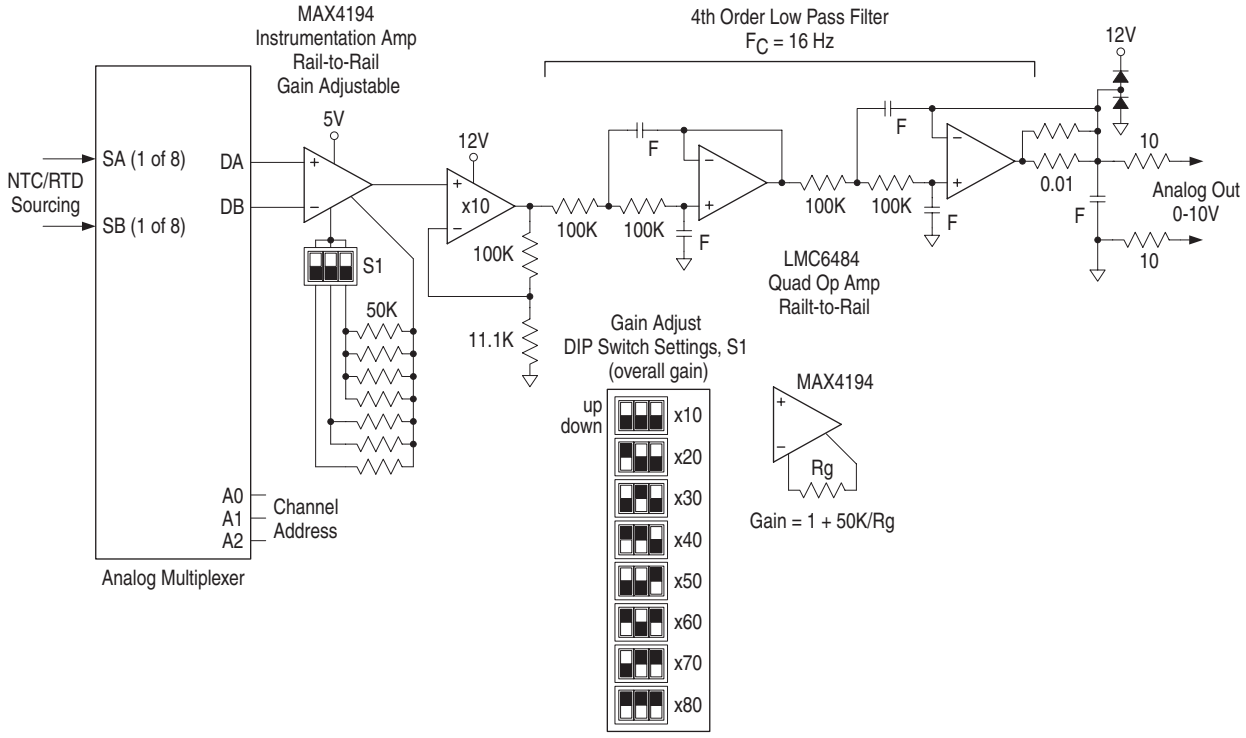
$$V_{MAX} = 1.00V \times R_{MAX} / (R_{MAX} + 998)$$

3. Select the largest gain that results in V_{MAX} * Gain (x10, x20, or x40), being less than 10 volts.

Example:

Using a 100 Ohm Pt RTD (a = 0.00385) to measure temperatures from 0…200 °C, the maximum resistance occurs at 200 °C and is approximately 177 Ohm. The maximum voltage across the sensor is 151 mV. If the x40 gain is used, the output voltage at 200 °C is 6.04 Volts.

Figure 17 Scaled Analog Output for RTD Board



Digital I/O

The digital outputs are isolated with solid state relays. The outputs are internally short circuit protected. The digital input is optically isolated.

Microcontroller Software

A microcontroller monitors three DIP switches to determine the operational mode of the RTD board. A single “Mode” switch determines whether the board uses an internal timebase or the digital input as a clock to step through the eight analog input channels. When using the internal timebase, the other two DIP switches select one of four clock periods.

When the “Mode” switch is up (open) the board uses the digital input as an enable/reset. When the board’s digital input is inactive (open or ground), the analog output is held at the first channel. When the digital input is active (24V), the microcontroller sequentially cycles through the eight temperature sensor channels. Each channel is available at the analog output for the selected period of time. After the eighth channel is completed, the cycle begins again with the first channel. Deactivating the digital input will asynchronously reset the sequence back to the first channel. The “Time” jumpers/DIP switches select one of four time periods between temperature sensor channels.

Table 13 Microcontroller Settings

Time Period	S2-2	S2-3
1 second	Down	Down
10 seconds	Up	Down
30 seconds	Down	Up
60 seconds	Up	Up

When the “Mode” switch (S2-1) is down (closed), the board uses the digital input as an external clock to sequentially cycle through the eight temperature sensor channels. The analog output channel advances with both the rising and falling edges of the digital input. In both modes, the active channel is output as a 3-bit binary address on the RTD board’s digital outputs. An inactive output (open) indicates a “0.” When using the digital input as an external clock, it may be necessary to monitor the address lines in order to maintain synchronization with the controller. When using the internal clock mode, the digital outputs may be ignored to reduce the required number of I/O. In either mode, the board’s digital input is debounced with a period of 50 milliseconds.

Step 6 Start-Up Check List

- This check list supports the Basic Start-Up menu option. See page 41 for information on other start-up routines.
- A Human Interface Module (HIM) is required to run the Basic Start-Up routine.
- The Basic Start-Up routine may modify parameter values for Analog and Digital I/O. Refer to Common I/O Programming Changes on page 45.

ATTENTION: Power must be applied to the drive to perform the following start-up procedure. Some of the voltages present are at incoming line potential. To avoid electric shock hazard or damage to equipment, only qualified service personnel should perform the following procedure. Thoroughly read and understand the procedure before beginning.

Prepare For Drive Start-Up

❑ **1.** Confirm that all inputs are connected to the correct terminals and are secure.

❑ **2.** Verify that AC line power at the disconnect device is within the rated value of the drive.

❑ **3.** Verify that control power voltage is correct.

❑ **4.** The remainder of this procedure requires that a Human Interface Module (HIM) be installed. Connect a HIM to Drive Peripheral Interface (DPI) Port 2 (item 4 in Figure 19 on page 44). If an operator interface is not available, remote devices should be used to start up the drive.

Important: When power is first applied, the HIM may require approximately 5 seconds until commands are recognized (including the Stop key). An explanation of the LED indicators can be found on page 44.

❑ **5.** Apply AC power and control voltages to the drive.

If any of the six digital inputs are configured to "Stop – CF" (CF = Clear Fault) or "Enable," verify that signals are present or reconfigure [Digital Inx Sel], Parameters 361…366. If an I/O option is not installed (that is, no I/O terminal block), verify that [Digital Inx Sel] is not configured to "Stop – CF" or "Enable." If this is not done, the drive will not start. Refer to Troubleshooting – Abbreviated Fault & Alarm Listing on page 46 for a list of potential digital input conflicts.

If the STS LED is not flashing green at this point, refer to Drive Status Indicators and DPI Port Locations on page 44.

❑ **6.** When prompted, select a display language. The PowerFlex 700 Start-Up Screen will then display.

❑ **7.** Press the Enter key to display the Start-Up Menu.

❑ **8.** Use the Arrow keys to highlight “2. Basic”.

❑ **9.** Press the Enter key. Follow the menu using the Enter key which will step you through the Start-Up routine.

The Basic Start-Up routine asks simple questions and prompts you to input required information. See also Common I/O Programming Changes on page 45.

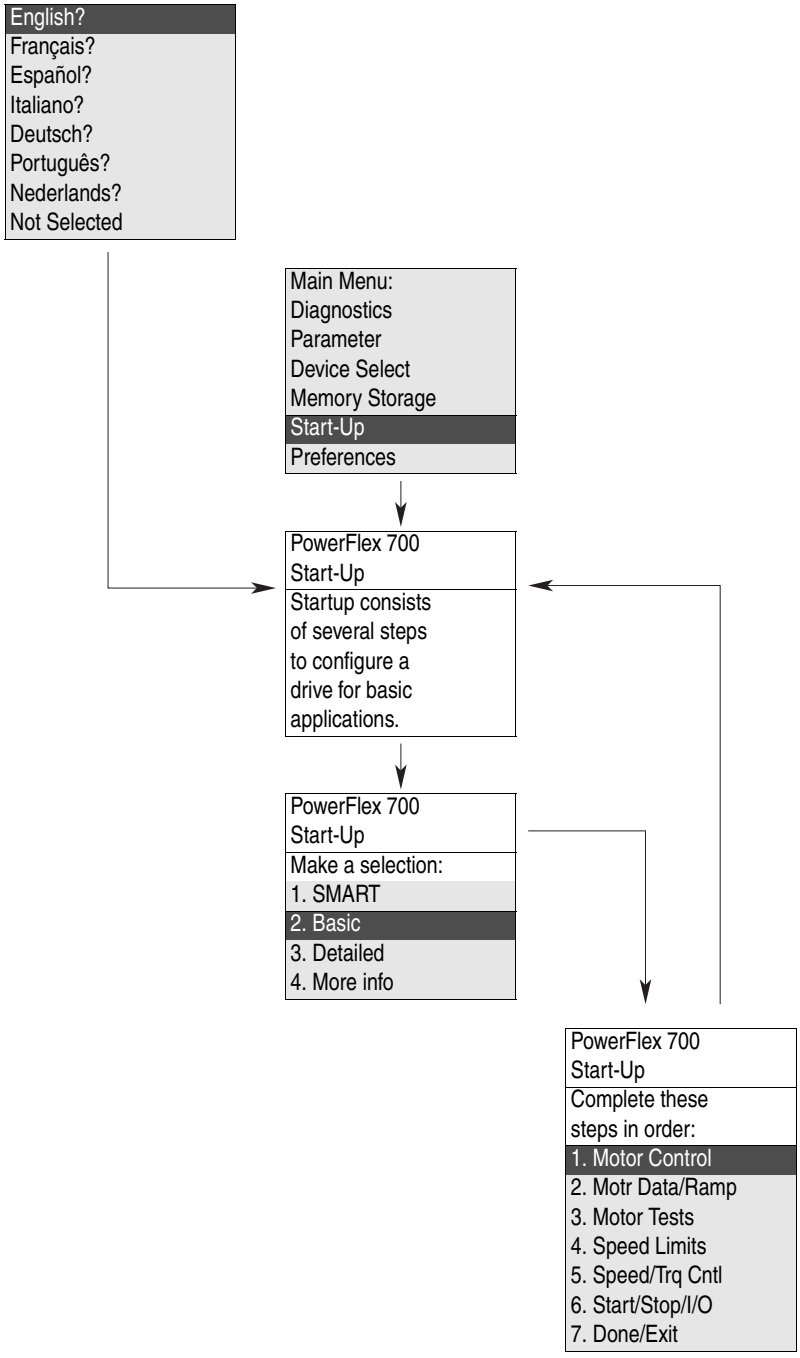
Information About Start-Up Motor Tests

Control schemes vary based on which Start/Jog Source is selected in Step 3 (Motor Tests) of the HIM Basic Start-Up procedure described in Assisted Start Up on page 41. The following table lists the Start/Jog Source for each selection:

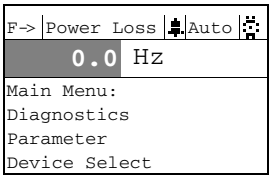
Start/Jog Source	Control Source Description
Digital Inputs	Digital In 1 = Stop; Digital In 2 = Start; Digital In 3 = Jog
Local Human Interface Module (HIM) – Port 1	Human Interface Module (HIM) connected to DPI Port 1 controls Stop/ Start/Jog Digital In 1…6 are temporarily disabled during motor tests.
Remote HIM	Human Interface Module (HIM) connected to DPI Port 2 controls Stop/ Start/Jog Digital In 1…6 are temporarily disabled during motor tests.

During motor tests and tuning procedures, the drive may modify certain parameter values for proper Start Up operation. These values are then reset to their original values when Start Up is complete. The affected parameters are 053, 080, 276, 278, and 361…366. If power is removed from the drive during the tests without aborting the auto-tune procedure, these parameters may not reset to their original value. If this situation occurs, reset the drive to factory defaults (see Restoring Factory Defaults on page 45) and repeat the Start Up procedure.

First Powerup Menu Structure



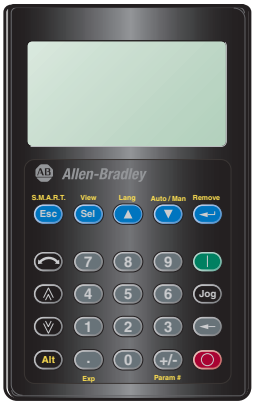
LCD Display Elements

Display	Description
	Direction | Drive Status | Alarm | Auto/Man | Information Commanded or Output Frequency Programming / Monitoring / Troubleshooting

Human Interface Module (HIM) Key Functions

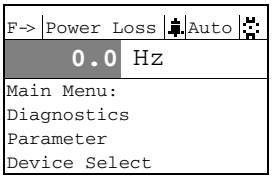
Key	Description
Esc	Exit a menu, cancel a change to a parameter value, or acknowledge a fault/alarm.
Sel	Select a digit, select a bit, or enter edit mode in a parameter screen.
▲	Scroll through options, increase a value, or toggle a bit.
▼	Scroll through options, decrease a value, or toggle a bit.
↵	Enter a menu, enter edit mode in a parameter screen, or save a change to a parameter value.
ALT	Access the function associated with a programming or numeric key. See ALT Functions on page 41 for details.
|	Start the drive.
○	Stop the drive or clear a fault.
Jog	Jog the drive.
↶	Change direction.
⩓	Increase speed.
⩔	Decrease speed.

These keys are active only when the HIM is granted Manual Control, or Parameter 090 [Speed Ref A Sel] or 093 [Speed Ref B Sel] is set to option "19" (DPI Port 2) for a HIM connected by cable for handheld or remote installation.



Human Interface Module (HIM)

Human Interface Module (HIM) Main Menu

Main Menu Screen	Menu Selections
	Main Menu: Diagnostics Parameter Device Select Memory Storage Start-Up Preferences

ALT Functions

To use an ALT function, start at the Main Menu and press the ALT key, release it, then press the programming key associated with one of the following functions:

ALT Key...then		Function	Function Description
	Esc	S.M.A.R.T.	Displays the S.M.A.R.T. screen. This function allows the drive parameter values to be quickly programed by directly accessing the most frequently used drive functions. Refer to Running S.M.A.R.T. Start on page 43 for more information.
	Esc	Log In/Out	Log in to change parameter settings. Log out to protect parameter settings. Change a password.
	Sel	View	Allows the selection of how parameters will be viewed or detailed information about a parameter or component.
ALT	Sel	Device	Select a connected adapter for editing.
	▲	Lang	Displays the language selection screen. The LCD Human Interface Module (HIM) on an architecture class drive allows you to change the display language any time.
	▼	Auto/Man	Switches between Auto and Manual Modes. If the Human Interface Module (HIM) requests Manual Mode, the Speed Reference source is transferred to the Human Interface Module (HIM).
	↵	Remove	Allows Human Interface Module (HIM) removal without causing a fault if the Human Interface Module (HIM) is not the last controlling device and does not have Manual control of the drive.
	+/–	Param #	Allows entry of a parameter number for viewing/editing.

Start-Up Routines

The PowerFlex 700 start up routines allow the user to commission the drive more quickly and accurately. If you have an LCD HIM, two methods are provided.

- **S.M.A.R.T. Start**

  This routine is accessible by using the “ALT” function key on the LCD HIM. This keystroke brings up a list of parameters needed to program the eight most commonly adjusted drive functions. These include Start, Stop, Minimum Speed, Maximum Speed, Acceleration Time, Deceleration Time, Reference source (speed command) and Electronic Overload setting for the motor. No knowledge of parameter organization or access is required. S.M.A.R.T. Start can commission the drive in just a few minutes. See Running S.M.A.R.T. Start on page 43 for details.

- **Assisted Start Up**

  Three levels of Assisted Start Up (Basic, Detailed and Application) assist the user in commissioning the drive by asking simple Yes/No or “Enter Data” questions. The user is guided through the Start Up to reduce the amount of time necessary to get the drive “up and running.” The following are included in startup:

  – Input Voltage Ratings
  – Motor Data
  – Motor Tests & Auto-tuning

- Speed/Torque Control & Direction Limits
- Speed Reference
- Start & Stop Modes
- Ramp Setup
- Digital and Analog I/O
- Application Set-up (TorqProve, Oil Well Pumps, Positioning/Speed Profiling)

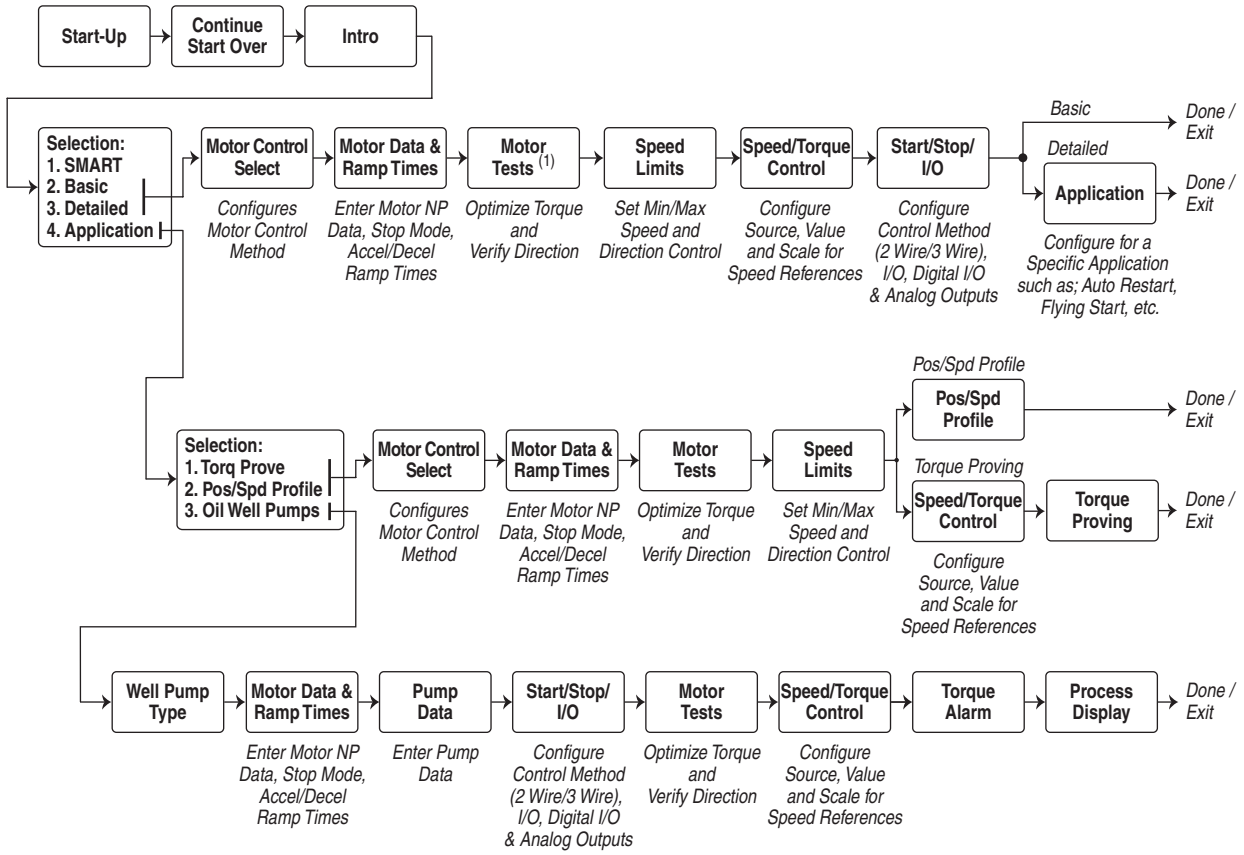
See Running an Assisted Start Up on page 43 for details.

Important Information

Power must be applied to the drive when viewing or changing parameters. Previous programming may affect the drive status and operation when power is applied. If the I/O Cassette has been changed, a Reset Defaults operation must be performed.

Torque Proving applications can use the Assisted Start Up to tune the motor. However, it is recommended that the motor be disconnected from the hoist/crane equipment during the routine. If this is not possible, refer to the TorqProve Manual Start Up procedure in the *PowerFlex 700 Series B User Manual* (publication 20B-UM002).

Figure 18 Start Up Menu



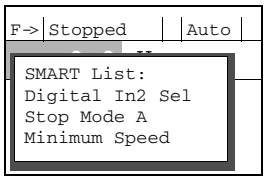
(1) During Motor Tests and tuning procedures, the drive may modify certain parameter values for proper Start Up operation. These values are then reset to their original values when Start Up is complete. The affected Parameters are 053, 080, 276, 278, and 361…366. If power is removed from the drive during the tests without aborting the auto-tune procedure, these parameters may not be reset to their original value. If this situation occurs, reset the drive to factory defaults and repeat the Start Up procedure.

Running S.M.A.R.T. Start

During a Start Up, the majority of applications require changes to only a few parameters. The LCD HIM used with the drive offers S.M.A.R.T. start, which displays the most commonly changed parameters. With these parameters, you can set the following functions:

S - Start Mode and Stop Mode
M - Minimum and Maximum Speed
A - Accel Time 1 and Decel Time 1
R - Reference Source
T - Thermal Motor Overload

To run a S.M.A.R.T. start routine:

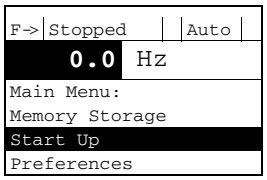
Step	Key(s)	Example LCD Displays
1. Press ALT and then Esc (S.M.A.R.T.). The S.M.A.R.T. start screen appears. 2. View and change parameter values as desired. For more HIM information, see Appendix B in the *PowerFlex 700 Series B User Manual* (publication 20B-UM002). 3. Press Esc to exit the S.M.A.R.T. start.	ALT Esc Esc	

Running an Assisted Start Up

Important: This start-up routine requires an LCD HIM.

The Assisted start-up routine prompts you to input required information. Access Assisted Start Up by selecting “Start Up” from the Main Menu.

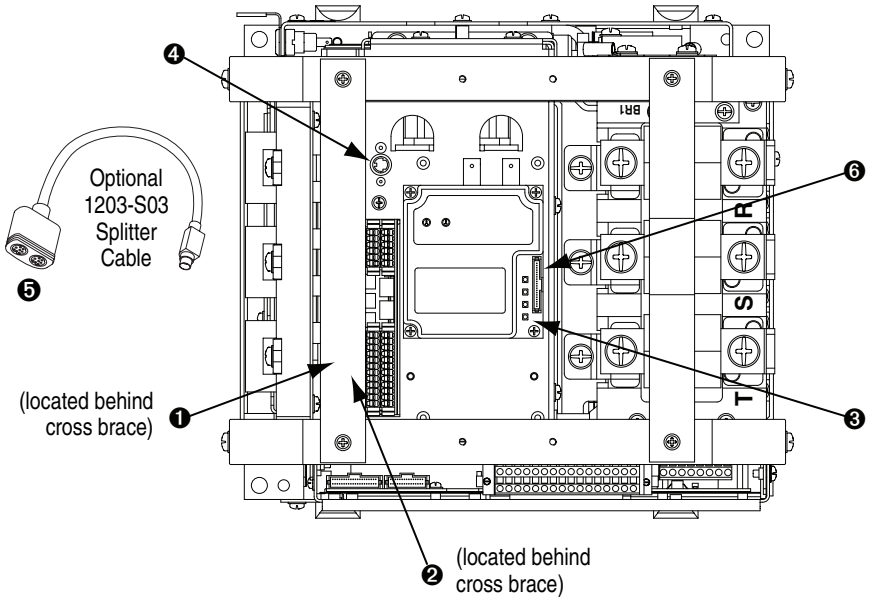
To perform an Assisted Start-Up

Step	Key(s)	Example LCD Displays
1. In the Main Menu, press the Up Arrow or Down Arrow to scroll to “Start Up”. 2. Press Enter.	 	

Important: Done/Exit must be selected upon completion of the Start Up routine in order for any Start Up/Autotune data to be saved.

Drive Status Indicators and DPI Port Locations

Figure 19 Drive Status Indicators and DPI Port Locations



No.	Name	Color	State	Description
❶	PWR (Power)	Green	Steady	Illuminates when power is applied to the drive.
❷	STS (Status)	Green	Flashing	Drive ready, but not running and no faults are present.
			Steady	Drive running, no faults are present.
		Yellow	Flashing, Drive Stopped	A start inhibit condition exists, the drive cannot be started. Check Parameter 214 [Start Inhibits].
			Flashing, Drive Running	An intermittent type 1 alarm condition is occurring. Check Parameter 211 [Drive Alarm 1].
			Steady, Drive Running	A continuous type 1 alarm condition exists. Check Parameter 211 [Drive Alarm 1].
		Red	Flashing	Fault has occurred. Check [Fault x Code] or Fault Queue.
			Steady	A non-resettable fault has occurred.
❸	PORT	Optional Communication Adapter (refer to User Manual)		Status of DPI port internal communications (if present).
	MOD			Status of communications module (when installed).
	NET A			Status of network (if connected).
	NET B			Status of secondary network (if connected).

No.	Connector	Description
❹	DPI Port 2	Cable connection for handheld and remote options.
❺	DPI Port 3 or 2	1203-S03 splitter cable (purchased separately) connected to DPI Port 2 provides additional port.
❻	DPI Port 5	Cable connection for optional communications adapter.

Common I/O Programming Changes

Your application needs may require changing parameters from their factory default settings.

Speed Reference A

Change Speed Reference A from Analog In 2 to Analog In 1 to connect an external potentiometer.

1. Set Parameter 090 [Speed Ref A Sel] to option “1” (Analog In 1).

   This sets the speed reference input to I/O terminals 14 and 15 for voltage and I/O terminals 16 and 17 for current.

2. Set Parameter 096 [TB Man Ref Sel] to option “9” (MOP Level).

   This eliminates a potential Conflict alarm condition. Analog In 2 is not a valid Speed Reference source if selected for any of the following:

   - Parameter 117 [Trim In Select]
   - Parameter 126 [PI Reference Sel]
   - Parameter 128 [PI Feedback Sel]
   - Parameter 147 [Current Lmt Sel]

3. Set Parameter 091 [Speed Ref A Hi] to the upper value of the desired speed reference range in Hz.

4. Set Parameter 092 [Speed Ref A Lo] to the lower value of the desired speed reference range in Hz.

Control Scheme

Change from 3 Wire Start/Stop to 2 Wire Run/Not Run at Digital In 1 and Digital In 2.

Important: This will disable the Start button on the HIM.

1. Set Parameter 361 [Digital In1 Sel] to option “7” (Run) or “9” (Run Reverse).

2. Set Parameter 362 [Digital In2 Sel] to another option such as “8” (Run Forward) or “10” (Jog1).

See I/O Wiring Examples on page 27.

Restoring Factory Defaults

From the Human Interface Module (HIM) Main Menu select: Memory Storage / Reset To Defaults

Troubleshooting – Abbreviated Fault & Alarm Listing

For a complete listing of Faults and Alarms, refer to the *PowerFlex 700 Series B User Manual* (publication 20B-UM002).

Fault	No.	Type[1]	Description	Action
Auxiliary Input	2	①	Auxiliary input interlock is open.	Check remote wiring.
Decel Inhibit	24	③	The drive is not following a commanded deceleration because it is attempting to limit bus voltage.	1. Verify input voltage is within drive specified limits. 2. Verify system ground impedance follows proper grounding techniques. 3. Disable bus regulation and/or add dynamic brake resistor and/or extend deceleration time. **Refer to page 4 for further info.** 4. Disable with Parameter 238.
FluxAmpsRef Range	78		The value for flux amps determined by the Autotune procedure exceeds the programmed [Motor NP FLA], Parameter 042.	1. Reprogram Parameter 042 [Motor NP FLA] with the correct motor nameplate value. 2. Repeat Autotune.
HW OverCurrent	12	①	The drive output current has exceeded the hardware current limit.	Check programming. Check for excess load, improper DC boost setting, DC brake volts set too high or other causes of excess current.
IR Volts Range	77		"Calculate" is the autotune default and the value determined by the autotune procedure for IR Drop Volts is not in the range of acceptable values.	Re-enter motor nameplate data.
Motor Overload	7	① ③	Internal electronic overload trip. Enable/Disable with Parameter 238 [Fault Config 1].	An excessive motor load exists. Reduce load so drive output current does not exceed the current set by Parameter 042 [Motor NP FLA].
OverSpeed Limit	25	①	Functions such as Slip Compensation or Bus Regulation have attempted to add an output frequency adjustment greater than that programmed in Parameter 083 [Overspeed Limit].	Remove excessive load or overhauling conditions or increase Parameter 083 [Overspeed Limit].
OverVoltage	5	①	DC bus voltage exceeded maximum value.	Monitor the AC line for high line voltage or transient conditions. Bus overvoltage can also be caused by motor regeneration. Extend the decel time or install dynamic brake option.
SW OverCurrent	36	①	Drive output current has exceeded the 1ms current rating. This rating is greater than the 3 second current rating and less than the hardware overcurrent fault level. It is typically 200…250% of the drive continuous rating.	Check for excess load, improper DC boost setting. DC brake volts set too high.

(1) See the User Manual for a description of fault types.

<table>
<tr><th>Alarm</th><th>No.</th><th>Type(1)</th><th>Description</th></tr>
<tr><td>Dig In ConflictA</td><td>17</td><td>②</td><td>Digital input functions are in conflict. Combinations marked with a "●" will cause an alarm.
<table>
<tr><th></th><th>Acc2/Dec2</th><th>Accel 2</th><th>Decel 2</th><th>Jog 1/2</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd/Rev</th></tr>
<tr><td>Acc2/Dec2</td><td></td><td>●</td><td>●</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Accel 2</td><td>●</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Decel 2</td><td>●</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog 1/2</td><td></td><td></td><td></td><td></td><td>●</td><td>●</td><td></td></tr>
<tr><td>Jog Fwd</td><td></td><td></td><td></td><td>●</td><td></td><td></td><td>●</td></tr>
<tr><td>Jog Rev</td><td></td><td></td><td></td><td>●</td><td></td><td></td><td>●</td></tr>
<tr><td>Fwd/Rev</td><td></td><td></td><td></td><td></td><td>●</td><td>●</td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictB</td><td>18</td><td>②</td><td>A digital Start input has been configured without a Stop input or other functions are in conflict. Combinations that conflict are marked with a "●" and will cause an alarm.
<table>
<tr><th></th><th>Start</th><th>Stop-CF</th><th>Run</th><th>Run Fwd</th><th>Run Rev</th><th>Jog 1/2</th><th>Jog Fwd</th><th>Jog Rev</th><th>Fwd/Rev</th></tr>
<tr><td>Start</td><td></td><td></td><td>●</td><td>●</td><td>●</td><td></td><td>●</td><td>●</td><td></td></tr>
<tr><td>Stop-CF</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Run</td><td>●</td><td></td><td></td><td>●</td><td>●</td><td></td><td>●</td><td>●</td><td></td></tr>
<tr><td>Run Fwd</td><td>●</td><td></td><td>●</td><td></td><td></td><td>●</td><td></td><td></td><td>●</td></tr>
<tr><td>Run Rev</td><td>●</td><td></td><td>●</td><td></td><td></td><td>●</td><td></td><td></td><td>●</td></tr>
<tr><td>Jog 1/2</td><td></td><td></td><td></td><td>●</td><td>●</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog Fwd</td><td>●</td><td></td><td>●</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Jog Rev</td><td>●</td><td></td><td>●</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Fwd/Rev</td><td></td><td></td><td></td><td>●</td><td>●</td><td></td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Dig In ConflictC</td><td>19</td><td>②</td><td>More than one physical input has been configured to the same input function. Multiple configurations are not allowed for the following input functions:
Forward/Reverse
Speed Select 1
Speed Select 2
Speed Select 3
Run Forward
Run Reverse
Jog Forward
Jog Reverse
Run
Stop Mode B
Bus Regulation Mode B
Acc2 / Dec2
Accel 2
Decel 2</td></tr>
<tr><td>TB Man Ref Cflct</td><td>30</td><td>②</td><td>Occurs when:
• "Auto/Manual" is selected (default) for Parameter 363 [Digital In3 Sel]
and
• Parameter 096 [TB Man Ref Sel] has been reprogrammed.
No other use for the selected analog input may be programmed.
Example: If Parameter 096 [TB Man Ref Sel] is reprogrammed to "2" (Analog In 2), all of the factory default uses for Analog In 2 must be reprogrammed (such as Parameters 90, 117, 128 and 179). Refer to the Auto/Manual Examples section of the PowerFlex 700 Series B User Manual.
To correct:
• Verify/reprogram the parameters that reference an analog input
or
• Reprogram Parameter 363 [Digital In3 Sel] to another function or "0" (Not Used).</td></tr>
</table>

(1) See the PowerFlex 700 Series B User Manual for a description of alarm types.

Drive does not Start from Start or Run Inputs wired to the terminal block.

Cause(s)	Indication	Corrective Action
Drive is Faulted	Flashing red status light	Clear fault. • Press Stop • Cycle power • Set [Fault Clear] to 1 • "Clear Faults" on the HIM Diagnostic menu.
Incorrect input wiring. Refer to the wiring examples starting on page 27. • 2 wire control requires Run, Run Forward, Run Reverse or Jog input. • 3 wire control requires Start and Stop inputs. • Jumper from terminal 25 to 26 is required.	None	Wire inputs correctly and/or install jumper.
Incorrect digital input programming. • Mutually exclusive choices have been made (that is, Jog and Jog Forward). • 2 wire and 3 wire programming may be conflicting. • Exclusive functions (that is, direction control) may have multiple inputs configured. • Stop is factory default and is not wired.	None	Program [Digital Inx Sel] Parameters 361…366 for correct inputs. Start or Run programming may be missing.
	Flashing yellow status light and "DigIn CflctB" indication on LCD HIM. Parameter 210 [Drive Status 2] shows type 2 alarm(s).	Program [Digital Inx Sel] Parameters 361…366 to resolve conflicts. Remove multiple selections for the same function. Install stop button to apply a signal at stop terminal.

Drive does not Start from Human Interface Module (HIM).

Cause(s)	Indication	Corrective Action
Drive is programmed for 2 wire control. HIM Start button is disabled for 2 wire control unless Parameter 192 [Save HIM Ref], bit 1 = "1."	None	If 2 wire control is required, no action needed. If 3 wire control is required, program [Digital Inx Sel] Parameters 361…366 for correct inputs.

Drive does not respond to changes in speed command.

Cause(s)	Indication	Corrective Action
No value is coming from the source of the command.	LCD HIM Status Line indicates “At Speed” and output is 0 Hz.	1. If the source is an analog input, check wiring and use a meter to check for presence of signal. 2. Check Parameter 002 [Commanded Speed] for correct source.
Incorrect reference source has been programmed.	None	3. Check Parameter 213 [Speed Ref Source] for the source of the speed reference. 4. Reprogram Parameter 090 [Speed Ref A Sel] for correct source.
Incorrect Reference source is being selected via remote device or digital inputs.	None	5. Check Parameter 209 [Drive Status 1], bits 12 and 13 for unexpected source selections. 6. Check Parameter 216 [Dig In Status] to see if inputs are selecting an alternate source. 7. Reprogram digital input Parameters 361…366 to correct “Speed Sel x” option.

Motor and/or drive will not accelerate to commanded speed.

Cause(s)	Indication	Corrective Action
Acceleration time is excessive.	None	Reprogram Parameter 140/141 [Accel Time x].
Excess load or short acceleration times force the drive into current limit, slowing or stopping acceleration.	None	Check Parameter 210 [Drive Status 2] bit 10 to see if the drive is in Current Limit. Remove excess load or reprogram Parameter 140/141 [Accel Time x].
Speed command source or value is not as expected.	None	Check for the proper Speed Command using Steps 1 through 7 above.
Programming is preventing the drive output from exceeding limiting values.	None	Check Parameters 082 [Maximum Speed] and 055 [Maximum Freq] to assure that speed is not limited by programming.

Motor operation is unstable.

Cause(s)	Indication	Corrective Action
Motor data was incorrectly entered or Autotune was not performed.	None	1. Correctly enter motor nameplate data. 2. Perform “Static” or “Rotate” Autotune procedure.

Drive will not reverse motor direction.

Cause(s)	Indication	Corrective Action
Digital input is not selected for reversing control.	None	Check Parameters 361…366 [Digital Inx Sel]. Choose correct input and program for reversing mode.
Digital input is incorrectly wired.	None	Check input wiring.
Direction mode parameter is incorrectly programmed.	None	Reprogram Parameter 190 [Direction Mode] for analog “Bipolar” or digital “Unipolar” control.
Motor wiring is improperly phased for reverse.	None	Switch two motor leads.
A bipolar analog speed command input is incorrectly wired or signal is absent.	None	1. Use meter to check that an analog input voltage is present. 2. Check wiring. Positive voltage commands forward direction. Negative voltage commands reverse direction.

Stopping the drive results in a Decel Inhibit fault.

Cause(s)	Indication	Corrective Action
The bus regulation feature is enabled and is halting deceleration due to excessive bus voltage. Excess bus voltage is normally due to excessive regenerated energy or unstable AC line input voltages. Internal timer has halted drive operation.	Decel Inhibit fault screen. LCD Status Line indicates “Faulted”.	1. See Attention statements on page 4. 2. Reprogram Parameters 161/162 [Bus Reg Mode x] to eliminate any “Adjust Freq” selection. 3. Disable bus regulation (Parameters 161 and 162) and add a dynamic brake. 4. Correct AC input line instability or add an isolation transformer. 5. Reset drive.

Manually Clearing Faults

Step	Key(s)
1. Press Esc to acknowledge the fault. The fault information will be removed so that you can use the Human Interface Module (HIM). 2. Address the condition that caused the fault. The cause must be corrected before the fault can be cleared. 3. After corrective action has been taken, clear the fault by one of these methods: • Press Stop • Cycle drive power • Set Parameter 240 [Fault Clear] to “1” (Clear Faults). • “Clear Faults” on the Human Interface Module (HIM) Diagnostic menu.	Esc

Parameter List – Vector Control Option (v6.xxx)

Number	Parameter Name	Group
1	Output Freq	Metering
2	Commanded Freq	Metering
3	Output Current	Metering
4	Torque Current	Metering
5	Flux Current	Metering
6	Output Voltage	Metering
7	Output Power	Metering
8	Output Powr Fctr	Metering
9	Elapsed MWh	Metering
10	Elapsed Run Time	Metering
11	MOP Reference	Metering
12	DC Bus Voltage	Metering
13	DC Bus Memory	Metering
14	Elapsed kWh	Metering
16	Analog In1 Value	Metering
17	Analog In2 Value	Metering
18	PTC HW Value	Metering
21	Spd Fdbk No Filt	Metering
22	Ramped Speed	Metering
23	Speed Reference	Metering
24	Commanded Torque**	Metering
25	Speed Feedback	Metering
26	Rated kW	Drive Data
27	Rated Volts	Drive Data
28	Rated Amps	Drive Data
29	Control SW Ver	Drive Data
40	Motor Type	Motor Data
41	Motor NP Volts	Motor Data
42	Motor NP FLA	Motor Data
43	Motor NP Hertz	Motor Data
44	Motor NP RPM	Motor Data
45	Motor NP Power	Motor Data
46	Mtr NP Pwr Units	Motor Data
47	Motor OL Hertz	Motor Data
48	Motor OL Factor	Motor Data
49	Motor Poles	Motor Data
50	Motor OL Mode[6.x]	Motor Data
53	Motor Cntl Sel	Torq Attributes
54	Maximum Voltage	Torq Attributes
55	Maximum Freq	Torq Attributes
56	Compensation	Torq Attributes
57	Flux Up Mode	Torq Attributes
58	Flux Up Time	Torq Attributes
59	SV Boost Filter	Torq Attributes
61	Autotune	Torq Attributes
62	IR Voltage Drop	Torq Attributes
63	Flux Current Ref	Torq Attributes
64	Ixo Voltage Drop	Torq Attributes
66	Autotune Torque**	Torq Attributes
67	Inertia Autotune**	Torq Attributes
69	Start/Acc Boost	Volts per Hertz
70	Run Boost*	Volts per Hertz
71	Break Voltage*	Volts per Hertz
72	Break Frequency*	Volts per Hertz
79	Speed Units	Spd Mode & Limits
80	Feedback Select	Spd Mode & Limits
81	Minimum Speed	Spd Mode & Limits
82	Maximum Speed	Spd Mode & Limits
83	Overspeed Limit	Spd Mode & Limits
84…86	Skip Frequency 1-3*	Spd Mode & Limits
87	Skip Freq Band*	Spd Mode & Limits
88	Speed/Torque Mod**	Spd Mode & Limits
90, 93	Speed Ref X Sel	Speed Reference
91, 94	Speed Ref X Hi	Speed Reference
92, 95	Speed Ref X Lo	Speed Reference
96	TB Man Ref Sel	Speed Reference
97	TB Man Ref Hi	Speed Reference
98	TB Man Ref Lo	Speed Reference
99	Pulse Input Ref	Speed Reference
100	Jog Speed 1	Discrete Speeds
101…107	Preset Speed 1-7	Discrete Speeds
108	Jog Speed 2	Discrete Speeds
116	Trim % Setpoint	Speed Trim
117	Trim In Select	Speed Trim
118	Trim Out Select	Speed Trim
119	Trim Hi	Speed Trim
120	Trim Lo	Speed Trim
121	Slip RPM @ FLA	Slip Comp
122	Slip Comp Gain*	Slip Comp
123	Slip RPM Meter	Slip Comp
124	PI Configuration	Process PI
125	PI Control	Process PI
126	PI Reference Sel	Process PI
127	PI Setpoint	Process PI
128	PI Feedback Sel	Process PI
129	PI Integral Time	Process PI
130	PI Prop Gain	Process PI
131	PI Lower Limit	Process PI
132	PI Upper Limit	Process PI
133	PI Preload	Process PI
134	PI Status	Process PI
135	PI Ref Meter	Process PI
136	PI Fdback Meter	Process PI
137	PI Error Meter	Process PI
138	PI Output Meter	Process PI
139	PI BW Filter	Process PI
140, 141	Accel Time X	Ramp Rates
142, 143	Decel Time X	Ramp Rates
145	DB While Stopped	Stop/Brake Modes
146	S Curve %	Ramp Rates
147	Current Lmt Sel	Load Limits
148	Current Lmt Val	Load Limits
149	Current Lmt Gain	Load Limits
150	Drive OL Mode	Load Limits
151	PWM Frequency	Load Limits
152	Droop RPM @ FLA	Load Limits

Number	Parameter Name	Group
153	Regen Power Limit**	Load Limits
154	Current Rate Limit**	Load Limits
155, 156	Stop Mode X	Stop/Brake Modes
157	DC Brk Lvl Sel	Stop/Brake Modes
158	DC Brake Level	Stop/Brake Modes
159	DC Brake Time	Stop/Brake Modes
160	Bus Reg Ki*	Stop/Brake Modes
161, 162	Bus Reg Mode X	Stop/Brake Modes
163	DB Resistor Type	Stop/Brake Modes
164	Bus Reg Kp*	Stop/Brake Modes
165	Bus Reg Kd*	Stop/Brake Modes
166	Flux Braking	Stop/Brake Modes
167	Powerup Delay	Restart Modes
168	Start At PowerUp	Restart Modes
169	Flying Start En	Restart Modes
170	Flying StartGain	Restart Modes
174	Auto Rstrt Tries	Restart Modes
175	Auto Rstrt Delay	Restart Modes
177	Gnd Warn Level	Power Loss
178	Sleep-Wake Mode	Restart Modes
179	Sleep-Wake Ref	Restart Modes
180	Wake Level	Restart Modes
181	Wake Time	Restart Modes
182	Sleep Level	Restart Modes
183	Sleep Time	Restart Modes
184	Power Loss Mode	Power Loss
185	Power Loss Time	Power Loss
186	Power Loss Level	Power Loss
187	Load Loss Level	Power Loss
188	Load Loss Time	Power Loss
189	Shear Pin Time	Power Loss
190	Direction Mode	Direction Config
192	Save HIM Ref	HIM Ref Config
193	Man Ref Preload	HIM Ref Config
194	Save MOP Ref	MOP Config
195	MOP Rate	MOP Config
196	Param Access Lvl	Drive Memory
197	Reset To Defalts	Drive Memory
198	Load Frm Usr Set	Drive Memory
199	Save To User Set	Drive Memory
200	Reset Meters	Drive Memory
201	Language	Drive Memory
202	Voltage Class	Drive Memory
203	Drive Checksum	Drive Memory
204	Dyn UserSet Cnfg	Drive Memory
205	Dyn UserSet Sel	Drive Memory
206	Dyn UserSet Actv	Drive Memory
209, 210	Drive Status X	Diagnostics
211, 212	Drive Alarm X	Diagnostics
213	Speed Ref Source	Diagnostics
214	Start Inhibits	Diagnostics
215	Last Stop Source	Diagnostics
216	Dig In Status	Diagnostics
217	Dig Out Status	Diagnostics
218	Drive Temp	Diagnostics

Number	Parameter Name	Group
219	Drive OL Count	Diagnostics
220	Motor OL Count	Diagnostics
221	Mtr OL Trip Time	Diagnostics
222	Drive Status 3[6.x]	Diagnostics
223	Status 3 @ Fault[6.x]	Diagnostics
224	Fault Speed	Diagnostics
225	Fault Amps	Diagnostics
226	Fault Bus Volts	Diagnostics
227, 228	Status X @ Fault	Diagnostics
229, 230	Alarm X @ Fault	Diagnostics
234, 236	Testpoint X Sel	Diagnostics
235, 237	Testpoint X Data	Diagnostics
238	Fault Config 1	Faults
240	Fault Clear	Faults
241	Fault Clear Mode	Faults
242	Power Up Marker	Faults
243	Fault 1 Code	Faults
244	Fault 1 Time	Faults
245	Fault 2 Code	Faults
246	Fault 2 Time	Faults
247	Fault 3 Code	Faults
248	Fault 3 Time	Faults
249	Fault 4 Code	Faults
250	Fault 4 Time	Faults
251	Fault 5 Code	Faults
252	Fault 5 Time	Faults
253	Fault 6 Code	Faults
254	Fault 6 Time	Faults
255	Fault 7 Code	Faults
256	Fault 7 Time	Faults
257	Fault 8 Code	Faults
258	Fault 8 Time	Faults
259	Alarm Config 1	Alarms
261	Alarm Clear	Alarms
262…269	Alarm X Code	Alarms
270	DPI Baud Rate	Comm Control
271	Drive Logic Rslt	Comm Control
272	Drive Ref Rslt	Comm Control
273	Drive Ramp Rslt	Comm Control
274	DPI Port Sel	Comm Control
275	DPI Port Value	Comm Control
276	Logic Mask	Masks & Owners
		Security
277	Start Mask	Masks & Owners
278	Jog Mask	Masks & Owners
279	Direction Mask	Masks & Owners
280	Reference Mask	Masks & Owners
281	Accel Mask	Masks & Owners
282	Decel Mask	Masks & Owners
283	Fault Clr Mask	Masks & Owners
284	MOP Mask	Masks & Owners
285	Local Mask	Masks & Owners
288	Stop Owner	Masks & Owners
289	Start Owner	Masks & Owners
290	Jog Owner	Masks & Owners

Number	Parameter Name	Group
291	Direction Owner	Masks & Owners
292	Reference Owner	Masks & Owners
293	Accel Owner	Masks & Owners
294	Decel Owner	Masks & Owners
295	Fault Clr Owner	Masks & Owners
296	MOP Owner	Masks & Owners
297	Local Owner	Masks & Owners
298	DPI Ref Select	Comm Control
299	DPI Fdbk Select	Comm Control
300…307	Data In XX	Datalinks
308	HighRes Ref[6.x]	Datalinks
310…317	Data Out XX	Datalinks
320	Anlg In Config	Analog Inputs
321	Anlg In Sqr Root	Analog Inputs
322, 325	Analog In X Hi	Analog Inputs
323, 326	Analog In X Lo	Analog Inputs
324, 327	Analog In X Loss	Analog Inputs
340	Anlg Out Config	Analog Outputs
341	Anlg Out Absolut	Analog Outputs
342, 345	Analog OutX Sel	Analog Outputs
343, 346	Analog OutX Hi	Analog Outputs
344, 347	Analog OutX Lo	Analog Outputs
354, 355	Anlg OutX Scale	Analog Outputs
361…366	Digital InX Sel	Digital Inputs
377, 378	Anlg OutX Setpt	Analog Outputs
379	Dig Out Setpt	Digital Outputs
380, 384, 388	Digital OutX Sel	Digital Outputs
381, 385, 389	Dig OutX Level	Digital Outputs
382, 386, 390	Dig OutX OnTime	Digital Outputs
383, 387, 391	Dig OutX OffTime	Digital Outputs
392	Dig Out Invert	Digital Outputs
393	Dig Out Param	Digital Outputs
394	Dig Out Mask	Digital Outputs
411	DigIn DataLogic[6.x]	Digital Inputs
412	Motor Fdbk Type	Speed Feedback
413	Encoder PPR	Speed Feedback
414	Enc Position Fdbk	Speed Feedback
415	Encoder Speed	Speed Feedback
416	Fdbk Filter Sel	Speed Feedback
419	Notch Filter Freq**	Speed Feedback
420	Notch Filter K**	Speed Feedback
421	Marker Pulse	Speed Feedback
422	Pulse In Scale	Speed Feedback
423	Encoder Z Chan	Speed Feedback
427, 431	Torque Ref X Sel**	Torq Attributes
428, 432	Torque Ref X Hi**	Torq Attributes
429, 433	Torque Ref X Lo**	Torq Attributes
430	Torq Ref A Div**	Torq Attributes
434	Torque Ref B Mult**	Torq Attributes
435	Torque Setpoint**	Torq Attributes
436	Pos Torque Limit**	Torq Attributes
437	Neg Torque Limit**	Torq Attributes
438	Torque Setpoint2**	Torq Attributes
440	Control Status**	Torq Attributes
441	Mtr Tor Cur Ref**	Torq Attributes

Number	Parameter Name	Group
445	Ki Speed Loop**	Speed Regulator
446	Kp Speed Loop**	Speed Regulator
447	Kf Speed Loop**	Speed Regulator
448	Spd Err Filt BW[6.x]	Speed Regulator
449	Speed Desired BW**	Speed Regulator
450	Total Inertia**	Speed Regulator
451	Speed Loop Meter**	Speed Regulator
454	Rev Speed Limit**	Speed Regulator
459	PI Deriv Time	Process PI
460	PI Reference Hi	Process PI
461	PI Reference Lo	Process PI
462	PI Feedback Hi	Process PI
463	PI Feedback Lo	Process PI
464	PI Output Gain	Process PI
476, 482, 488, 494	ScaleX In Value	Scaled Blocks
477, 483, 489, 495	ScaleX In Hi	Scaled Blocks
478, 484, 490, 496	ScaleX In Lo	Scaled Blocks
479, 485, 491, 497	ScaleX Out Hi	Scaled Blocks
480, 486, 492, 498	ScaleX Out Lo	Scaled Blocks
481, 487, 493, 499	ScaleX Out Value	Scaled Blocks
595	Port Mask Act	Security
596	Write Mask Cfg	Security
597	Write Mask Act	Security
598	Logic Mask Act	Security
600	TorqProve Cnfg	Torq Proving
601	TorqProve Setup	Torq Proving
602	Spd Dev Band	Torq Proving
603	SpdBand Integrat	Torq Proving
604	Brk Release Time	Torq Proving
605	ZeroSpdFloatTime	Torq Proving
606	Float Tolerance	Torq Proving
607	Brk Set Time	Torq Proving
608	TorqLim SlewRate	Torq Proving
609	BrkSlip Count	Torq Proving
610	Brk Alarm Travel	Torq Proving
611	MicroPos Scale%	Torq Proving
612	TorqProve Status	Torq Proving
613	Brake Test Torq[6.x]	Torq Proving
631	Rod Load Torque	Oil Well Pump
632	TorqAlarm Level	Oil Well Pump
633	TorqAlarm Action	Oil Well Pump
634	TorqAlarm Dwell	Oil Well Pump
635	TorqAlrm Timeout	Oil Well Pump
636	TorqAlrm TO Act	Oil Well Pump
637	PCP Pump Sheave	Oil Well Pump
638	Max Rod Torque	Oil Well Pump
639	Min Rod Speed	Oil Well Pump
640	Max Rod Speed	Oil Well Pump
641	OilWell Pump Sel	Oil Well Pump
642	Gearbox Rating	Oil Well Pump
643	Gearbox Sheave	Oil Well Pump
644	Gearbox Ratio	Oil Well Pump
645	Motor Sheave	Oil Well Pump
646	Total Gear Ratio	Oil Well Pump
647	DB Resistor	Oil Well Pump

Number	Parameter Name	Group
648	Gearbox Limit	Oil Well Pump
650	Adj Volt Phase	Adjust Voltage
651	Adj Volt Select	Adjust Voltage
652	Adj Volt Ref Hi	Adjust Voltage
653	Adj Volt Ref Lo	Adjust Voltage
654…660	Adj Volt Preset1-7	Adjust Voltage
661	Min Adj Voltage	Adjust Voltage
662	Adj Volt Command	Adjust Voltage
663	MOP Adj VoltRate	Adjust Voltage
669	Adj Volt TrimSel	Adjust Voltage
670	Adj Volt Trim Hi	Adjust Voltage
671	Adj Volt Trim Lo	Adjust Voltage
672	Adj Volt Trim %	Adjust Voltage
675	Adj Volt AccTime	Adjust Voltage
676	Adj Volt DecTime	Adjust Voltage
677	Adj Volt S Curve	Adjust Voltage
700	Pos/Spd Prof Sts	ProfSetup/Status
701	Units Traveled	ProfSetup/Status
702	Home Position[6.x]	ProfSetup/Status
705	Pos/Spd Prof Cmd	ProfSetup/Status
707	Encoder Pos Tol	ProfSetup/Status
708	Counts Per Unit	ProfSetup/Status
711	Vel Override	ProfSetup/Status
713	Find Home Speed	ProfSetup/Status
714	Find Home Ramp	ProfSetup/Status
718	Pos Reg Filter	ProfSetup/Status
719	Pos Reg Gain	ProfSetup/Status
720, 730, 740, 750, 760, 770, 780, 790, 800, 810, 820, 830, 840, 850, 860, 870	Step x Type	Profile Setup
721, 731, 741, 751, 761, 771, 781, 791, 801, 811, 821, 831, 841, 851, 861, 871	Step x Velocity	Profile Setup
722, 732, 742, 752, 762, 772, 782, 792, 802, 812, 822, 832, 842, 852, 862, 872	Step x AccelTime	Profile Setup
723, 733, 743, 753, 763, 773, 783, 793, 803, 813, 823, 833, 843, 853, 863, 873	Step x DecelTime	Profile Setup
724, 734, 744, 754, 764, 774, 784, 794, 804, 814, 824, 834, 844, 854, 864, 874	Step x Value	Profile Setup
725, 735, 745, 755, 765, 775, 785, 795, 805, 815, 825, 835, 845, 855, 865, 875	Step x Dwell	Profile Setup
726, 736, 746, 756, 766, 776, 786, 796, 806, 816, 826, 836, 846, 856, 866, 876	Step x Batch	Profile Setup
727, 737, 747, 757, 767, 777, 787, 797, 807, 817, 827, 837, 847, 857, 867, 877	Step x Next	Profile Setup

* These parameters will only be displayed when parameter 053 [Motor Cntl Sel] is set to option “2” or “3.”

** These parameters will only be displayed when parameter 053 [Motor Cntl Sel] is set to option “4.”

[6.x] Firmware 6.002 and later.

Appendix

Specifications

Category	Specification	
Agency Certification	c UL us	Listed to UL508C and CAN/CSA-C2.2 No. 14-M91.
	CE	Marked for all applicable European Directives EMC Directive (2004/108/EC) EN 61800-3 Adjustable Speed electrical power drive systems Low Voltage Directive (2006/95/EC) EN 50178 Electronic Equipment for use in Power Installations
	The drive is also designed to meet the following specifications: NFPA 70 - US National Electrical Code NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems. IEC 146 - International Electrical Code	

Category	Specification		
Protection		**400V**	**480V**
	AC Input Overvoltage Trip:	528V AC	528V AC
	AC Input Undervoltage Trip:	340V AC	340V AC
	Bus Overvoltage Trip:	815V DC	815V DC
	Bus Undervoltage Shutoff/Fault:	300V DC	300V DC
	Nominal Bus Voltage:	600V DC	700V DC
	Heat Sink Thermistor:	Monitored by microprocessor overtemp trip	
	Drive Overcurrent Trip Software Overcurrent Trip: Hardware Overcurrent Trip:	 200% of rated current (typical) 220…300% of rated current (depending on drive rating)	
	Line Transients:	Up to 6000 volts peak per IEEE C62.41-1991	
	Control Logic Noise Immunity:	Showering arc transients up to 1500V peak	
	Power Ride-Thru	15 milliseconds at full load	
	Logic Control Ride-Thru:	0.5 seconds minimum, 2 seconds typical	
	Ground Fault Trip:	Phase-to-ground on drive output	
	Short Circuit Trip:	Phase-to-phase on drive output	
	Intermittent Overload	110% overload capability for up to 1 minute. 150% overload capability for up to 3 seconds.	
	Current Limit Capability	Proactive Current Limit programmable from 20…160% of rated output current. Independently programmable proportional and integral gain.	
	Electronic Motor Overload Protection	Class 10 protection with speed sensitive response. Investigated by U.L. to comply with N.E.C. Article 430. U.L. File E59272, volume 12.	
Environment	Altitude:	1000 m (3280 ft) maximum without derating. See Derate Guidelines on page 58 for operation above 1000 m (3280 ft).	
	Ambient Operating Temperature w/o Derating: IP20, NEMA 1:	 -10…60 °C (14…140 °F)	
	Storage Temperature (all constructions):	-40…70 °C (-40…158 °F)	
	Atmosphere:	**Important:** Drive **must not** be installed in an area where the ambient atmosphere contains volatile or corrosive gas, vapors or dust. If the drive is not going to be installed for a period of time, it must be stored in an area where it will not be exposed to a corrosive atmosphere.	

Category	Specification	
Environment *(continued)*	Relative Humidity:	5…95% non-condensing
	Shock:	40G peak for 6 milliseconds duration (±3.0 ms)
	Vibration: Sinusoidal: Random:	 0.35 mm (0.014 in.) constant displacement to a constant acceleration of 5G. 10…500 Hz, 1 octave/minute, 10 sweep cycles, 3 axes 0.05 g^2/Hz, 10…500 Hz, 3 axes at 30 minutes per axis
Electrical	Input Voltage:	480V RMS, +10%, -5% (operate to -50% with reduced power, -30% minimum precharge) Note: The PowerFlex Frame 1X drive requires a 3% input impedance.
	Input Frequency Range:	47…63 Hz.
	Line-to-Neutral Phase Imbalance Tolerance:	2%
	Output Voltage:	0…460V RMS at nominal 480V RMS input. Output will be 460V RMS.
	Output Frequency Range:	0…420 Hz
	Switching Frequency:	4 kHz base; 2, 4, 8, 10 kHz selectable with derating. Derating at 8 and 10 kHz.
	Continuous Output Power:	100 kW (150 HP)
	Continuous Output Current:	180 amps RMS
	Peak Output Current: 3 seconds Maximum: 1 minute:	 270 amps RMS (3 seconds per 60 seconds) 198 amps RMS (1 minute per 10 minutes)
	Efficiency at Maximum Power, Nominal Voltage:	> 97.5%
	Power Loss at Full Load:	1900 W at 100 kW
	Power Loss to Air:	200 W at 110 kW
Control	Method:	Sine-coded PWM with programmable carrier frequency.
	Carrier Frequency:	2…10 kHz. Drive rating based on 4 kHz. Derate Guidelines on page 58 for more information.
	Output Voltage Range:	0…rated motor voltage
	Output Frequency Range:	0…420 Hz
	Frequency Accuracy Digital Input: Analog Input:	 Within ± 0.01% of set output frequency. Within ± 0.4% of maximum output frequency
	Frequency Control:	Speed Regulation - with Slip Compensation (Volts per Hertz Mode) 0.5% of base speed across 40:1 speed range 40:1 operating range 10 rad/sec bandwidth
		Speed Regulation - with Slip Compensation (Sensorless Vector Mode) 0.5% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth
		Speed Regulation - with Feedback (Sensorless Vector Mode) 0.1% of base speed across 80:1 speed range 80:1 operating range 20 rad/sec bandwidth

Category	Specification	
Control *(continued)*	Speed Control:	Speed Regulation - without feedback (Vector Control Mode) 0.1% of base speed across 120:1 speed range 120:1 operating range 50 rad/sec bandwidth
		Speed Regulation - with feedback (Vector Control Mode) 0.001% of base speed across 120:1 speed range 1000:1 operating range 250 rad/sec bandwidth
	Torque Regulation:	Torque regulation without Feedback; ± 5%, 600 rad/sec bandwidth
		Torque regulation with Feedback; ± 2%, 2500 rad/sec bandwidth
	Selectable Motor Control:	Sensorless Vector with full tuning. Standard V/Hz with full custom capability and Vector Control with Force Technology (with and without feedback).
	Stop Modes	Multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, and S-curve.
	Accel/Decel	Two independently programmable accel and decel times. Each time may be programmed from 0-3600 seconds in 0.1 second increments.
Liquid Coolant	Coolant Type:	50% water / 50% propylene glycol
	Max. Particle Size in Coolant:	5 microns
	Minimum Flow Rate:	7.57 LPM (2 GPM)
	Nominal Flow Rate:	9.46 LPM (2.5 GPM)
	Maximum Flow Rate:	22.71 LPM (6 GPM)
	Pressure Drop:	< 0.34 bar at 9.46 LPM (5 psi at 2.5 GPM), 20 °C
	Maximum Coolant Temperature:	60 °C (140 °F)
	Maximum Inlet Pressure:	3.45 bar (50 psi)
Encoder	Type:	Incremental, dual channel
	Supply:	12V, 250 mA. 12V, 10 mA minimum inputs isolated with differential transmitter, 250 kHz maximum.
	Quadrature:	90°, ± 27 degrees at 25 °C
	Duty Cycle:	50%, ± 10%
	Requirements:	Encoders must be line driver type, quadrature (dual channel) or pulse (single channel), 8…15V DC output, single-ended or differential, and capable of supplying a minimum of 10 mA per channel. Maximum input frequency is 250 kHz. The Encoder Interface Board accepts 12V DC square-wave with a minimum high state of 7.0V DC (12 volt encoder). Maximum low state voltage is 0.4V DC.
Dynamic Brake Resistor	Regen DC Bus Voltage (V_d):	790 volts
	Minimum Ohms, External Brake Resistor	8.2 ohms

Heat Dissipation

Table 14 Watts Loss @ Rated Load, Speed, and PWM Carrier Frequency

Voltage	PWM Freq.	Watts Loss		
		Into Air	Into Liquid	Total
480V	4 kHz	200	1700	1900

Derate Guidelines

Altitude

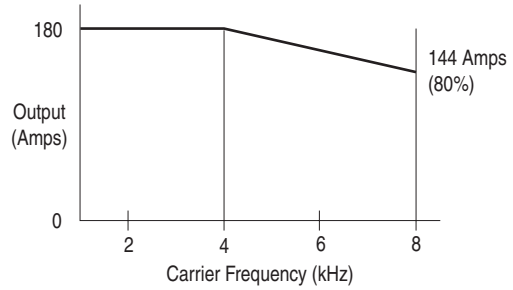
Above 1000 m (3280 ft), derate the output current by 1% for every 100 additional meters (328 additional feet). PowerFlex 700L Frame 1X drives should not be used above 2000 m (6562 ft) due to voltage spacing requirements.

Ambient

Frame 1X drives have a maximum ambient of 60 °C (140 °F). PowerFlex 700L drives cannot be derated to operate at higher temperatures.

Carrier Frequency

For Frame 1X drives, refer to the carrier frequency derating table below.



U.S. Allen-Bradley Drives Technical Support - Tel: (1) 262.512.8176, Fax: (1) 262.512.2222, Email: support@drives.ra.rockwell.com, Online: www.ab.com/support/abdrives

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 20L-IN013A-EN-P – June 2009

Copyright ® 2009 Rockwell Automation. All rights reserved. Printed in USA.